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# Guidelines for the Assessment of Transport Infrastructure Projects in Finland

Ministry of Transport
and Communications,
Helsinki, 2003

# PREFACE

The Guidelines for the Assessment of Transport Infrastructure Projects replace the earlier guidelines for project assessment (publications of the Ministry of Transport and Communications 4/1994 and 8/2000) and the previously confirmed unit values used in cost-benefit calculations (letters of the MTC 148/12/2001, 1272/12/2001 and 397/43/2002).

The purpose has been to gather up the valid guidelines and unit values into a single publication. Some clarifications have also been made regarding the required scope of the assessment, the choice of the Reference Alternative, taking account of the effects of changes in the operating environment, the qualitative assessment of impacts and the documentation of the assessment. Of the unit values used in cost-benefit calculations, those for the emission costs of air pollutants have been completely revised. The other values have been converted to euros, and some clarifications on their application have been added.

The process has been guided by a working group whose members have been Mr. Juha Parantainen and Mr. Tuomo Suvanto from the Ministry of Transport and Communications, Mr. Anton Goebel from the Finnish Road Administration, Mr. Martti Kerosuo and Mr. Harri Lahelma from the Finnish Rail Administration and Mr. Jukka Valjakka from the Finnish Maritime Administration. Representatives of the Ministry and the Administrations have commented a draft of the Guidelines. The report has been written by Mr. Heikki Metsäranta from Strafica Ltd where also Mr. Hannu Pesonen has participated in the work. Mr. Sami Yli-Karjanmaa from TMI SY-Arkki Co has translated this report into English.

The Guidelines are intended for the assessment of large-scale infrastructure projects but may also be applied in other transport schemes.

Helsinki, 23 June 2003

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# 1 INTRODUCTION

- **The assessment of a transport infrastructure project establishes the benefits and the costs of the project from the viewpoint of society at large. The purpose is to inform decision-making.**
- **The Guidelines for the Assessment of Transport Infrastructure Projects define the common principles to be adhered to in the assessment of road, railway and waterway infrastructure projects. Along with them, more detailed instructions and assessment methods are needed.**
- **The Guidelines are to be followed in the assessment of transport infrastructure projects proposed for action and financial plans, investment programmes or budgets of the Ministry of Transport and Communications. They may also be followed when assessing other transport projects.**
- **These Guidelines gather up in a single publication the earlier instructions and unit values. Some additions and clarifications have also been made.**

The purpose of the assessment of transport infrastructure projects is to produce background information for making investment decisions. Decision-making needs to prioritize projects representing different modes of transport, types of measures and areas. To this end, a procedure is needed to generate information that is comparable across different kinds of schemes.

The Guidelines for the Assessment of Transport Infrastructure Projects constitute an administrative ordinance validated by the Ministry of Transport and Communications. Issuing the Guidelines falls under the general powers of the Council of State, defined in the Constitution of Finland. The Guidelines are binding only on state authorities in the various branches of the transport administration under the MTC.

These Guidelines are to be followed in the assessment of all transport infrastructure projects proposed for action and financial plans, investment programmes or budgets of the MTC. They may also be applied when assessing other transport projects. In most cases, more detailed instructions are needed to complement the Guidelines. The Road, Rail and Maritime Administrations are responsible for producing and maintaining these. The Act (468/1994) and Decree (268/1999) on Environmental Impact Assessment Procedure make separate demands on the assessment of transport infrastructure projects. The two assessment procedures are not substitutes but valuable sources of information for each other.

The primary purpose of these Guidelines has been to gather up the earlier guidelines and unit values used in cost-benefit calculations into a single publication. Some clarifications and additions have also been made. As compared with the earlier guidelines, changes related to the following issues have been made:

- the scope of the assessment in different types of transport infrastructure projects (section 2.2);
- the Reference Alternative used in the assessment and the assumptions regarding the development of rest of the transport system and land use in the area concerned (chapter 3);

- defining the investment cost for the cost-benefit calculation (section 4.3.3);
- the qualitative assessment of impacts from different viewpoints (section 4.4); and,
- documenting and summarizing the assessment (sections 4.3.11 and 4.4.3, chapter 5).

Of the unit values used in cost-benefit calculations (section 4.3.2 and appendix 4), those for the emission costs of air pollutants have been completely revised for all modes of transport. The other values have been converted to euros, and some clarifications on their application have been added.

These Guidelines are for the most part permanent and valid indefinitely. They will be updated when a sufficient number of needs for changes have accrued to warrant the revision of the document. The intention is also to update the unit values relatively seldom.

Definitions of terms and concepts used in the Guidelines can be found in *Appendix 1*.

# 2 THE ASSESSMENT FRAMEWORK AND PROCESS

- **The components of the assessment of a transport infrastructure project are the description of the scheme, the description of the impacts and the assessment of the impacts, including the conclusions. The assessment is documented and a summary is drawn up.**
- **The input data used in the assessment is gathered from the plans and the design documents concerning the project, the Environmental Impact Statement or separate studies.**
- **The scope of the assessment varies by type of project.**
- **Preliminary assessment is carried out in the preliminary planning or a feasibility study phase. The actual assessment of the project, including the cost-benefit calculation, is performed in connection with the preliminary engineering and it is updated as the design process proceeds.**

## 2.1 The Stages of the Assessment

The assessment of a transport infrastructure project includes describing the project, collecting impact information and describing the impacts as well as assessing the impacts and making the conclusions. The assessment is documented and reported on, and a summary is drawn up.

*The description of the project* explains the problems for which solutions are sought through the project, the measures to be undertaken and the associated costs. The background and the characteristics of the project are described in such detail as is necessary for assessing the impacts.

*Impact information is collected* from preliminary planning and engineering documents, Environmental Impact Statements or possible separate studies. All existing data on the impacts of the scheme is taken into account. *The impacts are described* in a quantitative or qualitative manner.

(Part of) *the impacts are assessed* using a cost-benefit calculation and they are examined as a whole from different points of view. In addition, factors affecting the feasibility and the timing of the project are described and appraised. The main issue in the whole assessment task is to analyze the project and its impacts from different viewpoints. Based on the analysis, conclusions are made.

Sufficiently detailed *documentation* is necessary for the transparency and updatability of the assessment. The assessment is *reported on* and a *summary*, which is ultimately the most prominent part of the assessment, is drawn up. Particular attention needs to be paid to the consistency, argumentation and clarity of the reporting and the summary.

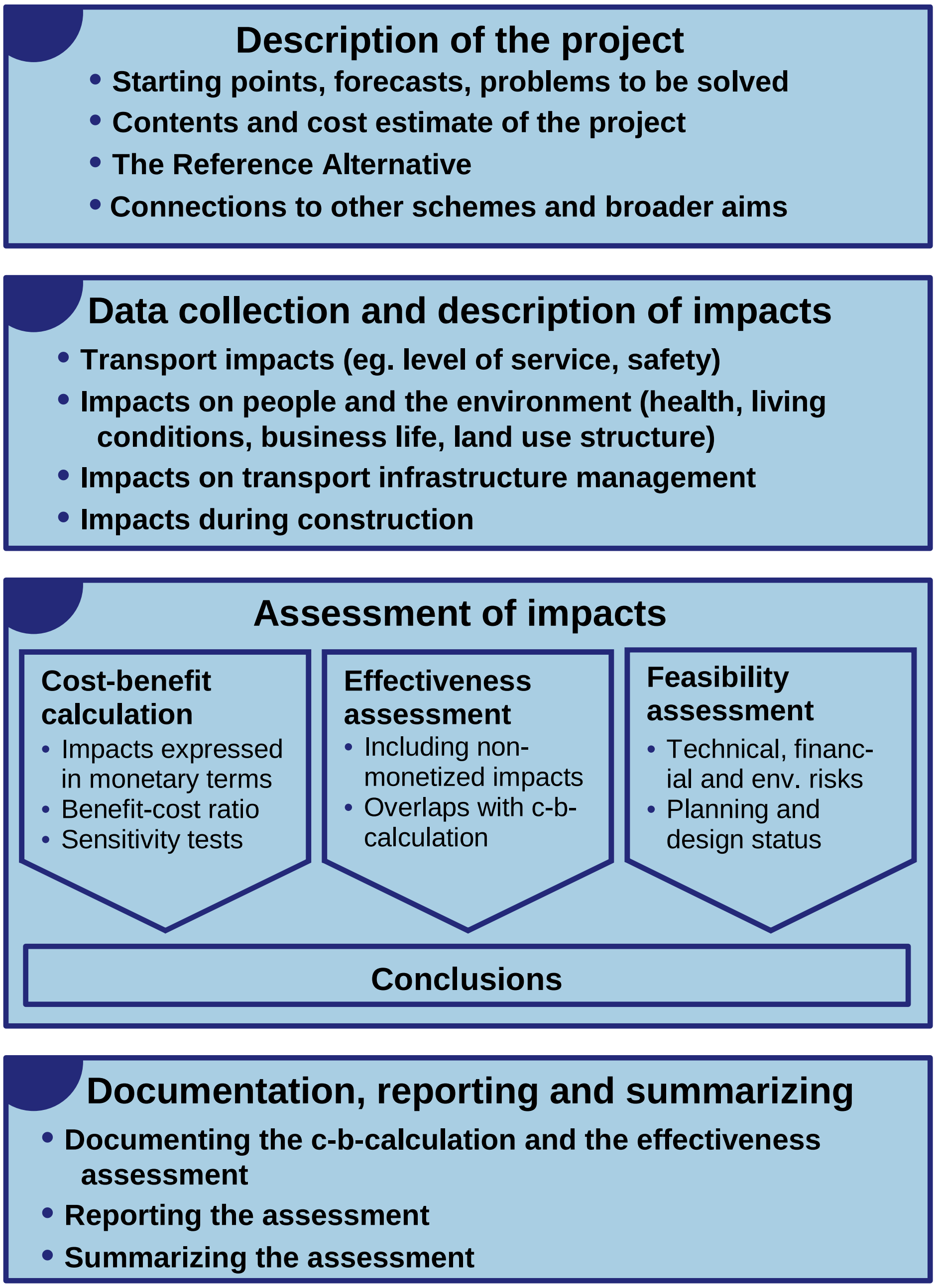



*Figure 1. The assessment framework for a transport infrastructure project.*

## 2.2 The Assessment of Different Kinds of Projects

Different kinds of projects require varying scopes of assessment. The scale of the project and the significance of its impacts affect the extent of the assessment. The assessment described in these Guidelines can be carried out either in a more limited or a broader manner depending on, inter alia, on the quantity and quality of the available input information. The main rule is that the assessment must be as thorough as the scale of the scheme and the significance of the impacts require. However, on a general level, the scope of the assessment of a transport infrastructure project is dependent on which type of a measure is concerned:

- a repair aiming at maintaining trafficability (a replacement investment);
- an increase of capacity or an improvement of the level of service (an expansion investment); or,
- a new piece of infrastructure improving the level of service of a network or a significant expansion of an existing one (a new investment).

The following general rules are to be followed:

- *A replacement investment* and its impacts are described as the Guidelines set forth. A cost-benefit calculation is usually not drawn up. The effectiveness or the feasibility of the scheme may be assessed. Generally, the benefit-cost ratio or the effectiveness are not relevant issues.
- In the case of an *expansion investment*, a cost-benefit calculation is drawn up provided that a significant part of the project's benefits and costs can be so assessed. If a considerable part of the benefits are non-monetary, the calculation is not made. In both cases, however, the effectiveness and the feasibility of the project are to be assessed. A cost-benefit calculation does not necessarily cover the essential impacts, which highlights the importance of the effectiveness assessment.
- *New investments* necessitate a full assessment as described in these Guidelines and including all the stages. A new investment expands a network or creates a new connection improving the level of service of the whole network, and usually both the costs and impacts involved are significant.

Exceptions to these general rules may be made if there are special reasons for doing so. For instance, it is warranted to draw up a thorough assessment and a calculation concerning a replacement investment if the question is whether to maintain or close down the route. On the other hand, it may be sufficient to make a limited assessment, with no calculation, of a new investment, if the cost estimate is low (e.g. €1–2m). It is also possible that most of the benefits of a new investment are non-monetary. In that case, the above rule for an expansion investment may be followed.

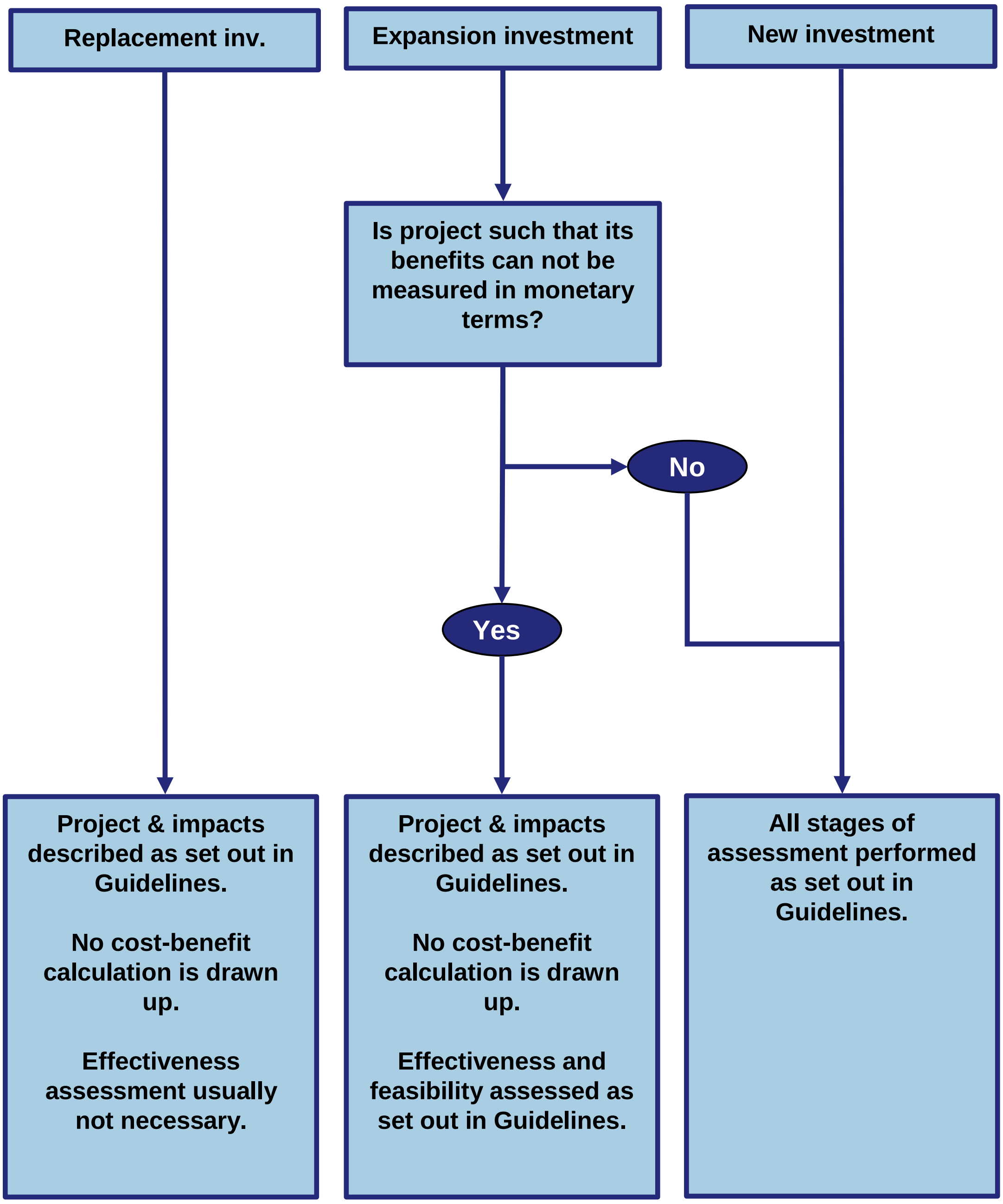



*Figure 2.* *Determining the scope of the assessment of a transport infrastructure project in ordinary cases.*

## 2.3 Assessment in the Various Phases of Planning and Design

The alternative ways to implement a project are studied during the whole planning and design process in order to distinguish between good and poor solutions. Comparing the options requires assessing their impacts. In the initial phases, assessment is not formal.

The first actual planning phase of a project is *preliminary planning* (e.g. a feasibility or a development study) where the need for and the timing of the project are surveyed. The result of preliminary planning is an outline of the project with preliminary descriptions of the alternative measures and their impacts including rough cost estimates. Based on these, a project description and a preliminary description and assessment of the impacts can be drawn up. The results of the preliminary assessment are used at this stage in deciding about the further planning of the project. What is essential is information on how well the project will solve the original problems and whether the benefits of the project seem to warrant further planning given the costs involved. In addition, any significant risks related e.g. to the technical feasibility of the project or to the environmental impacts need to be recognized.

*Preliminary engineering* defines the rough location of the infrastructure and the technical and functional solutions in such a manner that their economic and environmental feasibility can be ensured. The possible EIA process or other environmental assessment takes place at the preliminary engineering stage. The most useful information for impact assessment is produced during the preliminary engineering, and it is in practice not possible to draw up the actual impact assessment without this information. On the other hand, impact assessment generates valuable information for the design of technical and functional solutions. *Thus it is recommended that the actual project assessment be done in parallel and in interaction with preliminary engineering.* The final assessment of the project concerns the alternative that is arrived at in this phase. The assessment of the project is reported in the preliminary engineering document of the project. For decision-making, a separate summary is drawn up. In addition, the assessment is documented and reported on in accordance with these Guidelines.

In road planning, the next phase is *final engineering*. The final engineering document is validated legally after which it gives the right to expropriation of land if necessary. Final engineering specifies further the measures and the cost estimate. If the decision-making process has not been completed, the assessment of the project needs to be updated if new information becomes available. The changes are to be made to the summary of the assessment and they need to be mentioned in the assessment document. In rail and waterway projects, the corresponding phase does not exist; decisions are made based on the assessment carried out in the preliminary engineering phase.

The *final design* is related to the implementation of the project and is only done after the funding decision has been reached. It is generally not useful to carry out an assessment as set out in the Guidelines in such a late phase. However, information important for developing the assessment procedures is generated, as the costs and also contents of the project may still change during the final design and construction. Such changes should be able to be anticipated in the assessment. Progress reports are drawn up during construction, and the final report of the project is produced immediately after the project has been completed. Some years after the completion, an ex-post assessment covering several projects is drawn up. In this context, the materialization of the predicted impacts is reviewed.

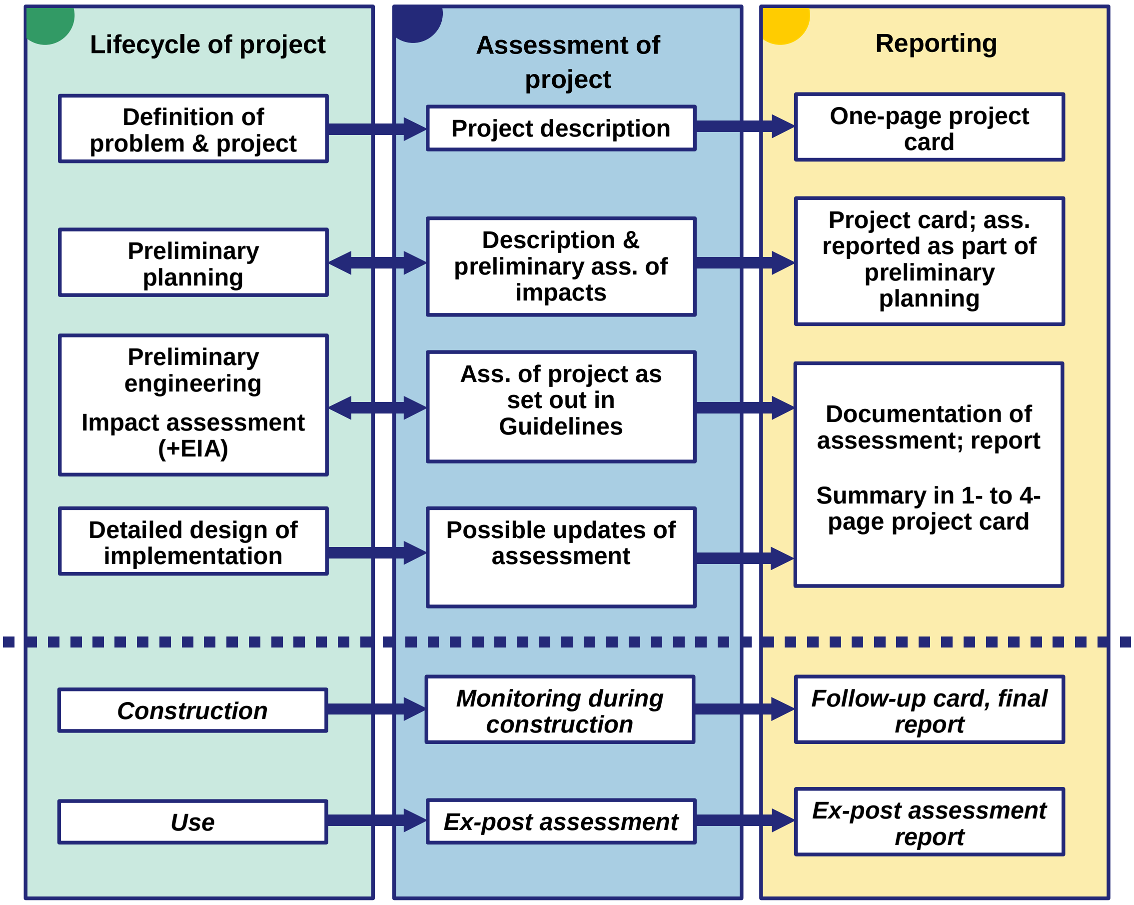



*Figure 3. The assessment of a transport infrastructure project at the various stages of its lifecycle.*

# 3 DEFINING THE ALTERNATIVES

- **The assessment of a project looks at the differences between an Investment Alternative and a Reference Alternative. The latter must be a realistic description of a situation where the Investment Alternative is not implemented.**
- **In most cases the Reference Alternative is the present situation as such (Do Nothing) or with improvements (Do Minimum). In some cases, an alternative land-use transport system without the investment (the so called HET alternative) needs to be defined as the Reference Alternative.**
- **The assumptions made about the development of the rest of the transport system and land use affect the results of the assessment. Either the present, a predicted or a dynamic operating environment may be taken as the point of departure for the assessment. The important thing is to assume a similar operating environment in both the Investment Alternative and the Reference Alternative.**

## 3.1 Choice of the Reference Alternative

The Reference Alternative is crucial for the results of the assessment of a transport infrastructure project. The choice of the Reference Alternative must always be justified and its contents need to be described in sufficient detail.

The general rule is that the Reference Alternative must strive to be realistic. It usually includes measures that are necessary and will implemented irrespective of the investment assessed. The Reference Alternative is usually one of the following:

- The *Do Nothing* alternative: Nothing is done about the problem, but land use, the rest of the transport system and the demand for transport develop as predicted.
- The *Do Minimum* alternative: The Investment Alternative is not implemented but replacement investments that are necessary for maintaining trafficability or improvements (minor as compared with the Investment Alternative) regarding e.g. traffic safety are carried out.
- *An alternative system without the project* (the HET alternative): The development of land use or of the other parts of the transport system is dependent on the project under consideration. The Reference Alternative has a transport and/or land-use system different from the one in the Investment Alternative.

Usually the *Do Nothing* alternative is chosen as the Reference Alternative of a transport infrastructure project. If it is not a real option, the *Do Minimum* is selected. If the project is an essential part of a larger development programme, an alternative system without the investment (the HET) is chosen as the Reference Alternative. For instance, realizing a new development that was meant to be supported by a new urban rail line when not implementing the rail line is not a realistic alternative. Instead, land use altogether different from the Investment Alternative should be used. In such a case, the subject of the assessment is a larger whole of transport or land-use development than just the project.

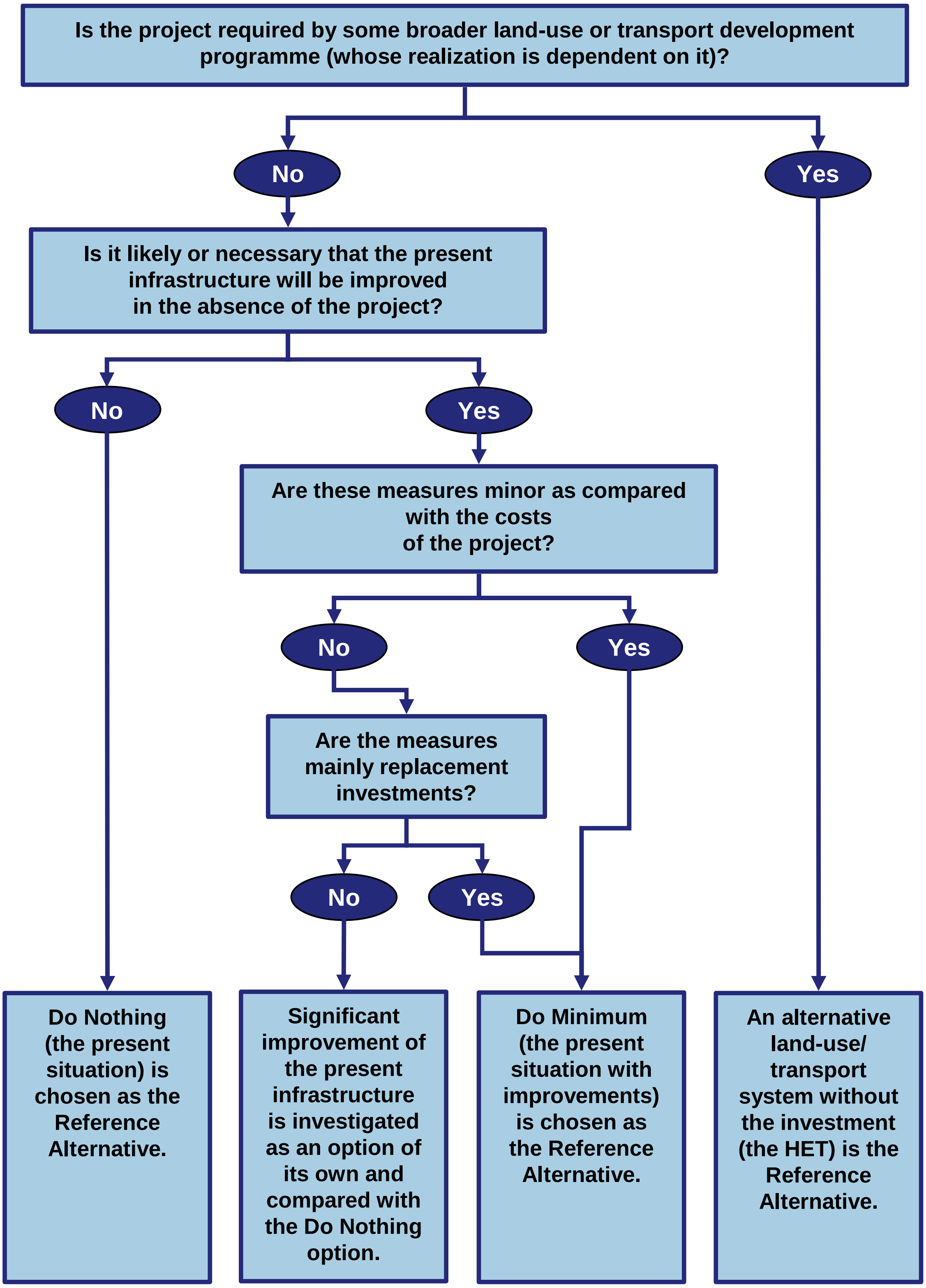



*Figure 4.* *Choosing the Reference Alternative.*

## 3.2 Assumptions Regarding the Development of the Rest of the Transport System and Land Use

It is likely that the transport system and land use of which the project is part will undergo changes irrespective of the project, before the implementation or afterwards. The assessment must be based on a realistic forecast about the changes in the transport system and land use as far as they have a marked impact on the benefits of the project.

The operating environment assumed in the assessment is usually one of the following:

- The rest of the transport system and land use remain as they are in the present situation throughout the period under consideration.
- The rest of the transport system and land use are in the same, forecast situation throughout the period under consideration.
- The rest of the transport system and land use change during the period under consideration.

The growth of traffic is taken into consideration in the same way in all cases. In other respects, the basic rule is that changes of the transport system and land use that affect the project's benefits and are either underway or settled are to be taken account of. Regarding other changes, deliberation is needed. For example, in transport system plans it is usually warranted to allow for those measures that have been programmed to be undertaken during the period under consideration. On the other hand, care must be taken in order not to distort the results of the assessment by assuming the implementation of very uncertain projects affecting the benefits of the scheme to be assessed.

*The Investment Alternative and the Reference Alternative must have a similar transport system and land use* with the exception of the project. Otherwise the result of the assessment no longer represents the impacts of the transport infrastructure project but those of changes in the operating environment.

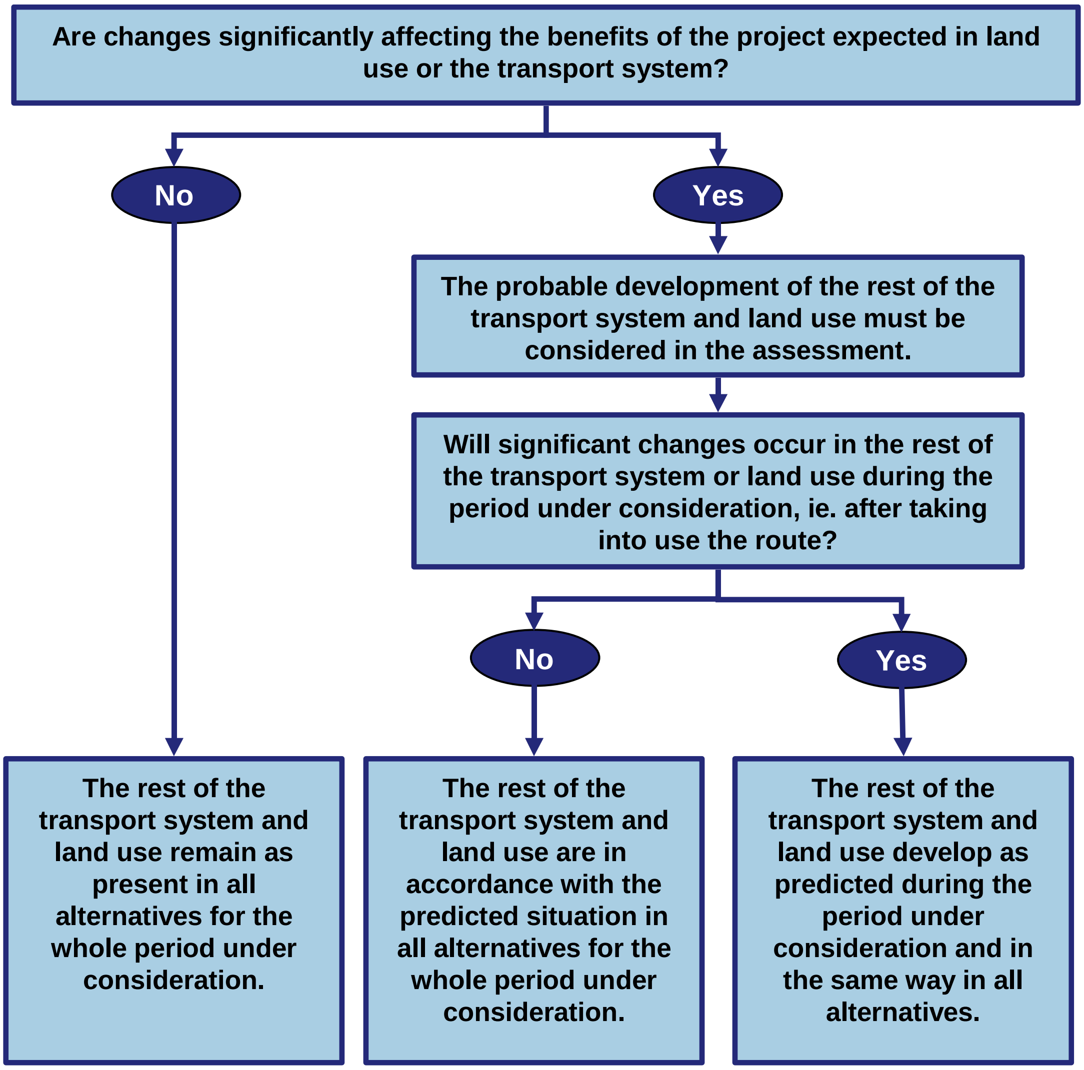



*Figure 5. Choosing the operating environment assumed in the assessment.*

# 4 THE COURSE OF THE ASSESSMENT

## 4.1 Description of the Project

- **The description of the project includes the problems to be solved, the contents of the project, the cost estimate, the planning and design status, the alternatives examined, the traffic forecasts used, the goals of the project and the connections with broader aims.**
- **Regarding the basis of the traffic forecasts, at least the population and economic forecasts, the transport system assumed, the prediction method employed and the growth rate of the demand for transport are presented.**
- **The goals of the project are described and any connections with e.g. agreements of intent and regional programmes are mentioned.**
- **The cost estimate is the sum for which a funding decision is sought. The sources of funding are mentioned. The investment costs are itemized by alternative. The implementation maturity is assessed technically in regard to the planning status without assumptions about decision-making.**

### 4.1.1 The Background, Problems and Forecasts

At the beginning of the assessment, a description of the problems to be solved or eliminated is presented. The scale of the problems is generally dependent on the traffic volumes. Therefore, it is important to describe the traffic forecast on which the project and the impact assessment are based.

At the background of a transport infrastructure project there may be even decades-old plans, alignments or decisions. The land use solutions related to the project may be important as well. All such things need to be described in sufficient detail so as to make the purpose of the project essentially clear.

The contents of the project and the changes it causes in the transport system have an impact on the total change of the amount of traffic (generated traffic), on the distribution of the traffic within the network and on the changes in the modal split. The traffic forecast is a significant starting point for the impact assessment. Therefore, the prediction method, the most important points of departure and the change in the demand for transport need to be presented. The contents of the documentation vary by type of project but at least the following issues are to be included in the case of an ordinary project:

- the development of the underlying factors of the demand for transport (e.g. forecasts of population or production);
- the assumptions made concerning the development of the rest of the transport system (as far as affects the need for the project);
- the prediction method;
- the growth rate of the demand for transport in the area; and,
- the growth of the demand for transport on the part of the network where the project is located.

***Case 1 The background of a harbour project.***

A national survey on port capacity has concluded that there exists a need for a new port or additional port capacity in the Helsinki region. Additional capacity is needed for the transport of unit cargoes. Earlier studies have found the location of Vuosaari to be logistically optimal.

The City of Helsinki has in its long-term planning undertaken preparations for moving the activities of the general cargo ports of Länsisatama and Sörnäinen to Vuosaari. This will release the present harbour areas to be used for residential and business purposes. In addition to fulfilling national logistic needs, the project is about extensive development of land use in the capital region. The present ports operate in centrally located areas that will not be suitable for cargo ports in the long term.

One starting point for the Vuosaari harbour is that the capacity of the present general cargo ports equals 8.6m tonnes, and this is expected to be exceeded during 2007. In 2000, the total amount of goods transported through the ports of Helsinki was 7.2m tonnes.

***Case 2 The prediction method used in a by-pass road project.***

The traffic forecast was drawn up with the EMME/2 software. The model used covers the city of Lahti and the surrounding municipalities. The present situation is based on the latest traffic and land use data (for 2000).

Based on these and predictions on land use and car ownership, a forecast for 2020 was drawn up. Growth coefficients were calculated for the traffic flows using the transport model, and the present, calibrated traffic flows were multiplied with them. For those zone pairs whose growth coefficient exceeds 2 (significant extent of new land use), the traffic flows have been produced with a transport model. The forecast concerns average daily traffic volumes and distinguishes between light and heavy vehicles.

The prediction on land use is based on the figures on residents and jobs in 2000 and a forecast for 2020 supplied by the City of Lahti. The number of inhabitants in Lahti in 2000 was 95 350 and that of jobs, 42 780. The corresponding figures for 2020 are 100 365 (+5%) and 48 690 (+12%).

The network assignments were done with the EMME/2 software using assignment methods and link descriptions that conform to the standards of the Road Administration. The the assignments of daily traffic (24h) take account of e.g. the capacity of the network and the impact of congestion on speeds. A so called Basic Network was used including the following additions to the present network:

- Highway 4 is a motorway up to Heinola.
- Highway 12 is a motorway between the centre of Nastola and Highway 4. In Kolava, there is an interchange with connections to the Karisto area as well as the waste management facility south of the road.
- Highway 24 has two carriageways, interchanges and a speed limit of 80 km/h.
- The southern road into the center of Lahti has four lanes.

According to the forecast, by 2020, traffic performance will increase by ca. 40% in the Lahti region. The traffic volumes of Highway 12 will increase by 30% to 40%. The growth of traffic is restricted by the insufficient capacity of the road.

Without a by-pass, capacity problems will emerge in particular on Highway 12 west of Helsingintie as well as on the southern ring street. Also, the traffic load on the street network of the centre will increase and the capacity of several junctions will be reached.

### 4.1.2 The Goals of the Project and Connections with Broader Aims

When presenting the goals of the project, the situation aimed at by the project is described. As a rule, it is presented to which extent the problems will be eliminated or alleviated.

In the description of the project, it also needs to be presented how the project relates to a larger whole. Connections worth mentioning are e.g. the following:

- the role of the project in regional transport system plans (agreements of intent);
- the status of the project in the regional programmes of Regional Councils (which include named transport projects); and,
- the position of the project in the National Land Use Goals (which include named transport corridors).

It is possible that the assessment looks at a project whose impacts are to a significant degree caused only by the implementation of a larger whole (e.g. the road, rail and waterway connections of a harbour). In such a case, the significance of the project for the whole is explained. If the project in itself does not create noteworthy impacts but is essential for the larger scheme, the whole assessment may be limited to a description of the project—in which context, however, the impacts of the whole scheme are brought out.

***Case 3 The objectives of an urban rail line and its connections with broader aims.***

The purpose of the project is to improve the level of service and competitiveness of public transport, to promote land use served by rail transport and to decrease road traffic and its environmental impacts.

The Kerava Urban Rail Line project is closely related to the marked increase of residents and jobs in the area. Present plans contain provisions for ca. 143 000 inhabitants (an increase of 30 000 from present) and 49 000 jobs (+16 000) in the immediate sphere of influence of the line.

The state, the cities of the Helsinki Metropolitan Area and the surrounding municipalities agreed in 2000 that the local authorities will guide the development of land use and residential construction so that use is made of public transport and especially rail transport. This is done in order to improve the land use structure and to promote the financial feasibility of transport investments.

In addition, the National Land Use Goals, adopted by the Council of State in 2000, state that the regional structure and urban form of the Helsinki region will be developed in a manner required by the growth of the population, and that public transport, rail transport in particular, as well as the surrounding network of towns and built-up areas will be made use of when selecting the growth directions.

### 4.1.3 The Contents and Implementation Maturity of the Project

The type and nature of the project, its location and the central quantitative data need to be presented. The description is illustrated with a figure presenting the location or the solution to be applied. In addition, the project description presents information on the planning and design status and the releated documents as well as the implementation maturity, i.e. how much time is still required for engineering as well as other related processes (land use planning, possible complaints).

Engineering standards are decisive in determining the minimum quality and quantity of the measures. Roads, railways and waterways each have their own standards. At the background of the standards are the impacts of the measures on e.g. safety, smoothness of traffic flows and the durability of structures. Within the limits defined by the standards, solutions differing greatly from each other in regard to their costs and impacts are, nevertheless, possible. For example, issues may come up during the environmental impact assessment that necessitate placing a road or railway in a tunnel or changing the alignment. The reasons for such exceptional and usually costly solutions need to be mentioned in the project description.

***Case 4 An urban road project and its implementation maturity.***

Ring Road I will be improved from Turunväylä to the border of the City of Helsinki (ca. 3.3km). In addition, Turunväylä will be improved between the Kauniainen junction and the border of Helsinki ( ca. 4km). The contents of the project are as follows:

- A third pair of lanes will be constructed on Ring I from Turuntie to the border of Helsinki and to Turunväylä.
- Ring I will be placed in a tunnel for a stretch of 500m north of Turuntie (Mestarintunneli).
- A new ramp will be built at the junction of Turunväylä and Ring I (from Turunväylä from the direction of Helsinki to Ring I westwards). The bus stop arrangements and the paths for pedestrians and cyclists will be improved.
- The Mestarinsolmu interchange will replace the traffic-lights controlled level crossings.
- A connection will be implemented from Turunväylä to the direction of Helsinki at Vermonsolmu, east of Ring I.
- The conditions for pedestrian and bicycle traffic will be improved both along Ring I and across it (grade-separated solutions). Noise abatement measures will be undertaken.


The Development Study of Ring I was completed in 1993. The Road Administration made the corresponding implementation decision in 1997. The Environmental Impact Statement was finalized in 1998. The preliminary engineering concerning the parts of the project located within the City of Espoo was completed in the summer of 1999, and the implementation decision based on it was made in September 2000. The final design phase is underway and will be ready during 2002.

In terms of planning and design, the project will be mature to be implemented during 2005. The implementation maturity for the first phase (the Turunväylä junction plus the new lanes) will be reached in 2003.

### 4.1.4 The Cost Estimate

The costs of the project are itemized and the most important items and subprojects are presented. The appropriate grouping is determined case by case. Usually, it is warranted to present the following items:

- The most significant individual cost items, e.g. tunnels, bridges or the foundation.
- The costs of measures targeted at a particular transport mode (e.g. the costs of measures related to public transport and pedestrian and bicycle traffic in road projects or to road transport and pedestrian and bicycle traffic in rail projects).
- The costs of noise abatement and groundwater protection.

It is necessary to distinguish between the costs of the project and those of such investments that will be made independently of the project. This usually implies that replacement investments and acute measures should be kept separate from expansion and development measures.

The cost estimate is presented without value added tax. In other words, the bottom line is the sum that would show in the state budget if the funding decision was made at that moment. The sum of value added tax is mentioned, however. If the cost estimate is not recent and the assessment does not include the making of a new one, the estimate is inflated to the present value using price indices. The soil construction price index is suited for the purpose if more exact information on the change of the price level is not available. The cost level must always be mentioned in conjunction with the cost estimate.

If the project has other sources of funding besides the state budget, this is mentioned. The shares of the different sources are itemized if they are known.

***Case 5 Itemization of the cost estimate of a road project.***

Price index of soil construction = 118.5 (1995=100)

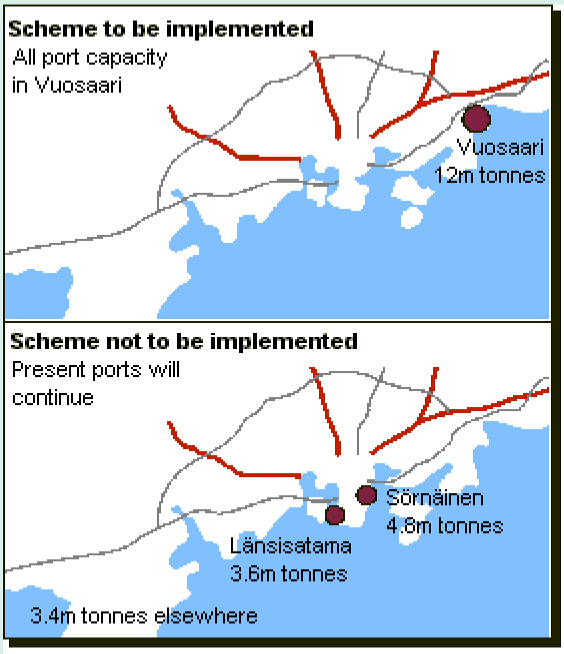
| | |
|---|---|
| Carriageway | €10.4m |
| Junctions | €6.3m |
| Arrangements for pedestrian and bicycle traffic | €1.5m |
| Arrangements for public transport | €8.1m |
| Other road arrangements | €7.5m |
| Noise abatement | €4.7m |
| Tunnels | €15.0m |
| **Total** | **€53.5m** |

### 4.1.5 Description of the Reference Alternative

The impact of the project means the difference in relation to the Reference Alternative. Therefore, the results of the assessment are decisively affected by how the Reference Alternative is defined and how well it is known. In the ideal case, the Reference Alternative is described in as great detail as the project.

***Case 6 The alternatives in a harbour project.***

Should the Vuosaari harbour not be built, cargo ports will continue to operate in Länsisatama and Sörnäinen. The capacity of the present ports is ca. 8.6m tonnes/year, and any transport beyond that will have to relocate.




It is assumed in the calculation that in the HET case (the project will not materialize) a new harbour with a capacity of 3.4m tonnes would built in the capital region. Also, investments will have to made in the channel as well as the road and rail connections of the new port. The investments would, at the 2001 price level, total €121m.

If the Länsisatama port will remain operational, the railway to it will also remain, and this would hinder the implementation of the plans concerning the Töölönlahti area. The calculations also assume that in the HET alternative a rail tunnel from Pasila to the Maria rail yard will be built. This would rule out those alternatives (A and B) of the Centre Tunnel that end in the Maria rail cutting. The cost estimate of the tunnel is €30m at the 2001 price level.

The street connection between the Länsisatama port and the Länsiväylä main road uses the Mechelininkatu street. This works reasonably well at present but the connection is very incident sensitive. Therefore, the HET alternative must contain provisions for enhancing the traffic arrangements in the Ruoholahti area. The transport authorities of the City of Helsinki and the Port of Helsinki have jointly studied the possibility of constructing a tunnel from Länsisatama to Länsiväylä. A rough cost estimate for this is €64m.

## 4.2 Description of the Impacts

- **All recognizable impacts of the project are described regardless of what or who is subject to them.**
- **Information on the impacts of the project is collected from planning and design documents and earlier studies, and it is complemented as needed during the assessment.**
- **The impacts are grouped in a way that is natural to the project.**
- **In describing the impacts considered (e.g. safety) and their distribution, the primary focus is on the difference between the Investment Alternative and the Reference Alternative.**
- **The sources of impact information are mentioned. Any important uncertainties are recorded and considered in sensitivity tests.**

### 4.2.1 Scoping and the Grouping of Impacts

The assessment is usually dependent on both the quantity and the quality of the results of earlier studies. In the assessment, those results are grouped and described in such detail that they can be assessed. In practice, it is possible, and often even inevitable, that some impacts are studied also during the assessment.

The point of view in the assessment of a transport infrastructure project is socio-economic. This means that all recognizable impacts are considered irrespective of what or who is subject to them and what they are like.

The following issues are of interest concerning all issues addressed in the assessment:

- What will be the development during the next 30 years without the project?
- What will be the development during the next 30 years with the project?
- What is the difference between the two?

In many cases, the difference between the alternatives can be established even if the present situation is not known. Sometimes impact assessments compare the forecast situation after the implementation of the project with the present situation. For instance, it is fitting to describe impacts on nature as changes caused by the project in relation to the present situation. However, in the assessment of a project it is essential that all the issues compared are timed in the same manner and considered in the forecast situation.

The impacts are first and foremost described in quantitative terms. If no quantitative data is available, a verbal description is given. There may also be impacts whose extent or even direction is not known but which are likely to emerge. It is important to mention these also. For all impacts, the source of information is mentioned: a document, an assessment method or an expert.

The grouping of impacts may vary by project type.

***Case 7*** ***Grouping of the impacts of an urban rail line.***

- Impacts on the level of service of public transport
- Impacts on the performance and costs of public transport
- Impacts on road transport and its costs
- Impacts on pedestrian and bicycle traffic
- Impacts on traffic safety
- Impacts on the noise, emissions and energy consumption of traffic
- Impacts on land use structure and the development of different areas
- Impacts on cityscape, landscape and the natural environment
- Impacts on the mobility possibilities for different groups of people
- Impacts on the maintenance costs of the transport network
- Impacts during construction

***Case 8*** ***Grouping of the impacts of a road project.***

- Impacts on the smoothness of the traffic flow
- Impacts on the reliability and punctuality of traffic
- Impacts on the performance and costs of traffic
- Impacts on public as well as pedestrian and bicycle traffic
- Impacts on safety
- Impacts on noise and emissions
- Impacts on social sustainability
- Impacts on land use structure and the development of different areas
- Impacts on cityscape and landscape
- Impacts on nature and natural resources
- Impacts on the maintenance costs of the transport network
- Impacts during construction

### 4.2.2 The Impacts Most Often Described

The primary purpose of a transport project is to generate **transport impacts**. Therefore, information is usually best available on them and that is why they also need to be described in the greatest detail in the assessment. The broader societal impacts of the project are caused by the transport impacts.

The general rule to be followed in the presentation of transport impacts is to describe all relevant impacts. One or more of the following types of impacts are usually dealt with:

- *pedestrian and bicycle traffic*—impacts on, inter alia, journey times, the general conditions, safety and flexibility of movement;
- *public transport*—impacts on, inter alia, journey times, operating costs, reliability, safety, punctuality, walking distances, waiting times and conditions, quality of travel and opportunities of using public transport;
- *car traffic*—impacts on, inter alia, speeds, journey times, routes, vehicle costs, driving comfort, flexibility of movement;
- *goods transport*—impacts on, intern alia, journey times, transport costs and reliability;
- *international transport*—impacts on, inter alia, the connections of border crossings, ports and international airports and, on the other hand, the operating conditions of sea and air transport;
- *intermodality*—impacts on, inter alia, the quality of feeder traffic, changes from one public transport vehicle to another and the cooperation or competition between road and rail transport; and,
- *traffic safety*—impacts on the total number of fatalities and personal injury accidents, preferably by mode.

The project itself or its transport impacts will affect society and the environment more broadly. These **non-transport impacts** usually occur in the following areas:

- *health and living conditions*—changes in the number of inhabitants within noise zones or in the area subject to noise, the barrier effect of the infrastructure, the connections of pedestrian and bicycle traffic and changes in the quantity and quality of significant green or recreation areas;
- *conditions for business life*—impacts on the smoothness of transport chains and commuter traffic;
- *soil, water, air, climate, organisms and biodiversity*—the land area required by the infrastructure and the harm caused or threat posed to areas with valuable nature, migration routes or habitats of animals, viability of nature and preservation of different kinds of natural habitats; and,
- *land use structure, buildings, landscape, cityscape and cultural heritage*—the relationship of the project to the land use goals of the area, impacts on the structure of land use, the risks of damage to sites important for their landscape, cityscape or cultural heritage, possibilities of improving the landscape or cityscape.

If the project has impacts on most of the areas mentioned above, it is warranted to separately mention those on which it *hasn't*. If the project only affects one area, the rest can be passed over with a categorical statement that the project will not cause other significant impacts.

Certain impacts may also be assumed to occur even though impact information is deficient on their part. The primary aim should then be to have them studied as part of the possibly ongoing preliminary engineering. Otherwise, it is to be separately mentioned that these impacts have not been studied.

A project usually also has impacts on the costs of the maintenance of infrastructure. This covers the costs of e.g. winter maintenance, lighting, renewing the pavement and the operating, maintenance and replacement costs of structures and equipment. Usually, upgrading the quality of infrastructure increases the maintenance costs. On the other hand, renovation carried out in conjunction with the investment under consideration may create savings in the maintenance costs. A monetary estimate is presented about the impacts. The project may also affect the timing of e.g. replacement or other investments or ice-braking or pilotage operations. Administrative costs may also be involved, and they need to be described if relevant.

## 4.3 Drawing Up the Cost-benefit Calculation

- **The following values are to be used in the calculation:**
  - **The base year is the first year after opening the route to traffic.**
  - **The calculation period is 30 years.**
  - **The discount rate is 5%.**
  - **The salvage value is, as a rule, no more than 25%.**
- **The cost-benefit calculation focuses on the difference between the Investment Alternative and the Reference Alternative. The calculation includes all benefits and costs that are affected by the project and for whose monetary assessment there is a clear method.**
- **Each benefit and cost item is taken into account only once. No economic knock-on or compound effects may be included.**
- **If the calculation contains transfer payments like taxes and rents, they are taken into account for both the recipient and payer.**
- **Unit and calculation values confirmed by the Ministry of Transport and Communications are used, without index adjustments, in valuing the benefits and costs. In addition, unit cost information from the Road, Rail and Maritime Administrations may be used.**
- **The result of the calculation is a benefit-cost ratio, and possibly other indicator values. The calculation is subjected to a sensitivity test.**
- **The cost-benefit calculation is documented in such detail that it is transparent and updatable.**

### 4.3.1 Socio-economic Cost-benefit Calculation

The cost-benefit calculation is the central method in analysing the impacts of a transport infrastructure project. It is carried out in conformity with the principles of socio-economic cost-benefit analysis. The phases of the calculation are as follows:

1. The investment cost to be used in the calculation is defined.
2. All the impacts that can be expressed in monetary terms are defined. Their distribution among the different transport modes or user groups is described in a way appropriate for the nature of the project.
3. The impacts are quantified and valued using the confirmed unit values. The absence of double counting or of one-sided inclusion of transfer payments is ascertained.
4. The benefits, disbenefits and the investment cost are converted to the present value of the basic year using the confirmed calculation values. The values of socio-economic feasibility indicators are calculated.
5. The calculation is documented in such detail that it is updatable.

The calculation values presented in Table 1 are used in cost-benefit calculations. Related calculation formulas are presented in *Appendix 2*.

*Table 1. The calculation values to be used in the cost-benefit calculation of a transport infrastructure project.*

| Calculation value | Guideline to be followed |
|---|---|
| Calculation period | The benefits and costs of the transport infrastructure project are calculated for a period of 30 years after the base year.<br>In addition, the period of construction before the base year is added to the calculation period. |
| Base year | The base year of the calculation is the first entire year after opening the route to traffic.<br>The investment cost, the benefits and the disbenefits are converted into the present value of the base year using the discount rate. |
| Discount rate | 5%. |
| Salvage value | The salvage value of the infrastructure at the end of the calculation period is estimated in relation to its expected life. The salvage value is normally, and no more than, 25% of the investment cost.<br>The salvage value is discounted to the base year and included as a benefit of the project. |
| Measures of socio-economic feasibility | The net benefit-cost ratio is always presented as the result of the cost-benefit calculation.<br>Additionally, the present value, the internal rate of return and the one-year rate of return may be presented. |

The benefits of the project are usually cost savings such as reductions of transport operating costs or shorter journey times. The disbenefits are usually cost increases like growing maintenance or emission costs. The basic indicator for the socio-economic feasibility of the project is the benefit-cost ratio:

**Benefit-cost ratio = (benefits – disbenefits) / investment cost**

Even though the basic rule is that all monetizable benefits and disbenefits are included, the contents of the calculation will in most cases be similar. The cost-benefit calculation of a transport infrastructure project usually includes the following items:

1. the investment cost of the project;
2. the salvage value of the investments and the possible avoided and indirect investments;
3. the change of the maintenance costs of the infrastructure;
4. the change of consumer surplus (usually includes the vehicle and travel time costs as well as the ticket and freight costs);
5. the change of the producer surplus of transport operators (usually includes the transport costs and ticket and freight revenues); and,
6. the changes in externalities (usually includes accident, emission and noise costs).

The cost-benefit calculation of a transport infrastructure project **must not include the following:**

- impacts for whose measurement and valuation no clear method can be shown to exist; or,
- certain economic knock-on or compound impacts such as those on employment, gross national product, or the economic growth or the structure of the economy of an area, because there is an apparent risk of double counting.

The cost-benefit calculations of all transport infrastructure projects must be made according to the same principles. In details, the calculations may differ from each other on the basis of the differences between the modes of transport and between projects. The present practice in scoping the cost-benefit calculations in different types of transport infrastructure projects is described in *Appendix 3*.

### 4.3.2 Valuation of Benefits and Costs

As a rule, all monetary and monetizable benefit and cost items are included in the calculation. Items that are naturally expressed in money include maintenance, transport operating and vehicle costs as well as ticket and freight costs and revenues. The quantification of these, too, requires unit cost information. Benefits and costs that are monetized usually involve travel time, accident, emission and noise costs. In principle, other monetized items can be included as well if the valuation method used is valid also for other projects and provided that the item is not taken into account in some other form. E.g. the impact of the project on the value of land or properties may not be included for it is, at least to an extent, covered by the change in travel time costs.

The following unit values presented in *Appendix 4* are to be used in the valuation:

1. the unit values for vehicle costs of road transport;
2. the unit values for travel time costs of road traffic which are also the basic values for other than road projects;
3. the unit values for accident costs of road traffic which are also the basic values for other than road projects;
4. the unit values for noise costs of road traffic which are also the basic values for other than road projects; and,
5. the unit values for emission costs as separately defined for road, rail and waterway transport.

In addition to these, unit price and cost information related to the following areas and produced by the transport Administrations may be needed in the calculation:

1. the costs of the maintenance of the route (plus other possible costs the route maintainer is liable for);
2. the transport operating units costs for waterway transport (vessel costs);
3. the transport operating units costs for rail transport; and,
4. the unit prices of the services of passenger and goods transport (fares and freight tariffs).

No calculation-specific index adjustments may be made.

*Table 2. Normal uses of unit values in cost-benefit calculations of road, rail and waterway projects.*

| Unit Values | Road Projects | Rail Projects | Waterway Projects |
|---|---|---|---|
| Unit values for vehicle costs of road traffic<br><br>Appendix 4<br>Table 5 | • Impacts of project on vehicle costs of road traffic. | • Impacts on vehicle costs of road traffic caused by a modal shift or e.g. removal of level crossings. | • Impacts on vehicle costs of road traffic caused by a modal shift (inland waterway projects). |
| Unit values for travel time costs of road traffic<br><br>Appendix 4<br>Table 6 | • Impacts of project on travel time costs of road traffic. | • Impacts of project on train passengers' travel time costs.<br>• Impacts on travel time costs of road traffic caused by a modal shift or e.g. removal of level crossings. | • Usually not needed. |
| Unit values for emission costs of road traffic<br><br>Appendix 4<br>Tables 7-8 | • Impacts of project on emission costs of road traffic. | • Impacts on emission costs of road traffic caused by a modal shift. | • Impacts on emission costs of road traffic caused by a modal shift. |
| Unit values for emission costs of rail traffic<br><br>Appendix 4<br>Tables 9-11 | • Usually not needed. | • Impacts of project on emission costs of rail traffic. | • Impacts on emission costs of rail traffic caused by a modal shift. |
| Unit values for emission costs of vessel traffic<br><br>Appendix 4<br>Tables 12 to 13 | • Usually not needed. | • Usually not needed. | • Impacts of project on emission costs of vessel traffic. |
| Unit values for noise costs of road traffic<br><br>Appendix 4<br>Table 14 | • Impacts of project on noise costs of road traffic. | • Impacts of project on noise costs of rail traffic.<br>• Impacts on noise costs of road traffic caused by a modal shift. | • Impacts of project on noise costs of vessel traffic.<br>• Impacts on noise costs of road and rail traffic caused by a modal shift. |
| Unit values for accident costs of road traffic<br><br>Appendix 4<br>Table 15 | • Impacts of project on accident costs of road traffic. | • Impacts of project on accident costs of rail traffic.<br>• Impacts on accident costs of road traffic caused by a modal shift. | • Impacts on accident costs of road traffic caused by a modal shift. |
| Unit values based on follow-up and estimates | • Impacts of project on road maintenance costs.<br>• Impacts of project on public transport costs of an urban region. | • Impacts of project on transport operating costs.<br>• Impacts of project on ticket and freight revenues and costs.<br>• Impacts of project on track maintenance costs.<br>• Impacts on road maintenance costs caused by a modal shift. | • Impacts of project on vessel costs.<br>• Impacts on road and track maintenance costs caused by a modal shift. |

### 4.3.3 Determining the Investment Cost

The cost-benefit calculation looks at the difference between the Investment Alternative and the Reference Alternative. Thus the investment cost of the Investment Alternative is included in the calculation only to the extent that it exceeds the costs of the investments made in the Reference Alternative. Correspondingly, the benefits and disbenefits brought about by the Reference Alternative are deducted from those of the project.

At least the following cases need to be considered in the treatment of the investment cost:

1. *measures that are common to the alternatives*—the project includes measures that would also be implemented in the Reference Alternative either at the same or a later time as in it;
2. *avoided measures*—the Reference Alternative includes measures that would not be implemented at all in the Investment Alternative; and,
3. *indirect investments*—some other actor (e.g. a municipality or a company) has to carry out a measure if the Investment Alternative is realized but not if the Reference Alternative is chosen (or vice versa).

If the Reference Alternative is a Do Minimum alternative (see Chapter 3), the costs of the *measures included in the Reference Alternative* are, as a rule, deducted from the investment cost of the project. At the same time, those benefits will also have to be deducted that are brought about by these measures, also in the Reference Alternative. If e.g. similar noise abatement measures are included in both alternatives, the costs of noise abatement are subtracted from the investment cost of the project and the noise cost savings from the benefits. The costs of replacement investments are usually deducted without compensation, because their benefits are not considered in the cost-benefit calculation.

The costs of the *avoided measures* are included in the calculation as a benefit timed to the year of implementing the measures in the Reference Alternative.

The possible *indirect investment* related to the Investment Alternative is considered in the calculation as a cost created in the estimated year of making the investment. An indirect investment related to the Reference Alternative is treated as a benefit of the project in the same manner. However, the implementation of the project under consideration needs to have an indisputable impact on the investments of other parties in order to warrant the inclusion of such investments.

All the investment costs are treated without indirect taxes, i.e. without value-added tax. Cost estimates are usually presented without tax, so no separate adjustments are needed. The latest cost estimates and the latest price level available are used in the calculation.

For the calculation of the benefit-cost ratio, the interest accruing during the period of construction is taken into account by converting the investment costs into the present value of the base year using the specified discount rate. The cost to which the benefit-cost ratio is related must be clearly expressed in the calculation.

***Case 9*** ***Investments common to all the alternatives and those avoided in the Investment Alternative of an urban rail line project.***

**The investments included in the Do Minimum alternative**

The project includes measures that will be realized with or without the rail line. However, it is practical to implement them simultaneously with the construction of the line. Some of the investments are only partially related to the project.

In the cost-benefit calculation, certain costs have been deducted from the investment: costs that would probably materialize in any case and whose benefits have not been included in the calculation. These investments (€7.6m in total) are as follows:

- underpasses of the present rail tracks of Peijaksentie, €2.7m;
- renovating the underpass of the present tracks of Kalmuuri and Kaatopaikantie, €1.2m;
- noise abatement, €2.4m; and,
- underpass at Urpia, €1.3m.

**The investments avoided**

If the urban rail line will not be implemented, the future land use will need to be supported by bus transport. There is no space in downtown Helsinki for the bus platforms of the Do Minimum alternative, which is why terminals would have to be invested in. As only little space is available and the price of land is high, it is not realistic to assume the construction of surface terminals. Instead, the new terminals would need to be built underground. The terminal-related costs are estimated at €2.8m. Avoiding these costs is regarded as a benefit of the scheme, and it has been timed to the year of taking the rail line into use (2005) when the number of services is reduced by 20 departures/peak hour.

***Case 10*** ***The indirect investments in the harbour project.***

In order to use the area of the Sörnäinen port for residential construction, investments worth €12m need to be made in the nearby Hanasaari power plant in 2010. The present value of these costs in 2008 is €11m. Additionally, the project will necessitate investments in the Vuosaari A power plant (€1.7m) and replacing the present boat places owned by the City of Vantaa (€1.5m). These investments have, however, already been made or are in the process of being realized, and they have not been taken into account in the calculation.

The project will also require *bringing forward* road improvement measures of Porvoonväylä, Itäväylä and Ring Road III. It has been assumed in the calculation that it is a question of five years, and this causes calculative interest costs worth €6m. On the other hand, there will be benefits also to other traffic than that of the port, and these have been taken account of when calculating the total transport benefits of the capital region.

### 4.3.4 The Salvage Value of the Investment

The salvage value means the value of the investment at the end of the calculation period, i.e. after 30 years of use. It is defined as a fixed share of the investment cost based on the estimated life of the investment. In the assessment of transport infrastructure projects the salvage value is, as a rule, 25% of the investment cost. This is based on the assumption that the average life of a transport infrastructure project is 40 years at the most and that the value decreases linearly. If the life of the investment is shorter, a smaller salvage value is used. However, a greater salvage value may not be used even when the life of the investment is expected to exceed 40 years, for it is not warranted to assume that the use value of a piece of infrastructure will in the distant future be as great as today. The salvage value is discounted to the base year and included as a benefit of the project.

### 4.3.5 The Discount Rate

The various benefits and costs to be generated in different years are made commensurable by discounting them to the base year. The discount rate represents the social time preference and not e.g. the real interest of a loan taken by the state. It is not justified to use the interest rate defined by the State Treasury because, inter alia, the variation of the rate would render comparisons between projects difficult. The discount rate used in the calculations is a matter of discretion. For the time being, it has been agreed that the rate used in the cost-benefit calculations of transport infrastructure projects is 5%.

### 4.3.6 Costs of Route Maintenance

The maintenance costs of the route or related structures or equipment may increase or decrease as a result of the project. The project may e.g. include components whose life is, for technical or economic reasons, clearly shorter than the calculation period. The replacement costs of these are taken into account as maintenance costs. If modal shifts result from the project, there will be impacts on the maintenance costs of other modes as well. The estimated annual differences in regard to the Reference Alternative are discounted to the base year and included as benefits or costs in the calculation.

### 4.3.7 Change of Consumer Surplus (Vehicle, Travel Time and Fare Costs)

If the user of a transport service perceives that the benefit s/he gains exceeds the price paid the user has a so-called consumer surplus. A transport project usually affects the benefits of private car users, public transport passengers and buyers of transport services. Besides monetary costs, quality factors such as travel comfort, amount of leisure time needed for travelling and the opportunity to work during the journey also have an impact on the benefits of the consumer.

The change in consumer surplus is measured with generalized costs. Cost items included are vehicle costs (fuel, maintenance, tyres etc.), travel time costs and ticket and freight costs. These will change as a result of the project and affect consumer surplus. The unit values presented in *Appendix 4* are used in calculating the changes (see also section 4.3.2). The same principles must be applied to the calculations of all transport infrastructure projects, but the details of the calculations may vary because of the differences between projects.

If the cost changes cannot be calculated on the whole transport network, the change in consumer surplus of the present traffic can be calculated by multiplying the change in the generalized costs (per unit) by the traffic volume of the Reference Alternative. If the project causes modal shifts from other modes or generates new traffic, the benefits of the new and shifting traffic can be estimate using the so called rule of the half. This means that new or shifting traffic gains benefits that are, per unit, half the benefits of the present traffic. This is based on the assumption that the demand for transport increases in a linear relation to the decrease of the generalized costs.

### 4.3.8 Change of Producer Surplus (Transport Operating Costs and Revenues)

If a transport operator incurs more revenues than costs for producing services, so-called producer surplus is created. Usually, the costs of transport operators used in cost-benefit calculations are those of transport operation. Correspondingly, the operator gains ticket and freight revenues by which it covers the costs. The change in producer surplus is calculated as the net change in the costs and revenues of transport operators (see also section 4.3.2 and *Appendix 4*).

### 4.3.9 External Costs (Accident and Environmental Costs)

The impacts of the project on accident, emission and noise costs are considered in the cost-benefit calculation. The unit values presented in *Appendix 4* are used (see also section 4.3.2).

*Accident costs* are included in projects affecting road or rail transport. In road traffic, pedestrian and bicycle accidents are considered alongside of motor vehicle accidents. The unit costs determined by the Road Administration are used in the calculation of the accident costs of all transport modes.

*Emission costs* are taken into account in road, rail and waterway projects. Unit costs to be used have been separately defined and confirmed for each transport mode.

*Noise costs* are included in road and rail projects. For both modes, the unit costs determined by the Road Administration are, for the time being, used.

### 4.3.10 Sensitivity Tests

A sensitivity analysis needs to be performed on the cost-benefit calculation whereby the impacts of the largest uncertainties of the socio-economic feasibility of the project on the benefit-cost ratio are assessed. These factors will be different in different projects and thus the sensitivity tests must be designed case by case. It is not warranted to carry out sensitivity tests regarding the calculation values (section 4.3.1) or the unit values (section 4.3.2 and *Appendix 4*), as these are the same for all projects.

Generally, the most significant uncertainties affecting a single transport infrastructure project are the cost estimate, traffic forecasts with the related population and land use predictions and the development options of the rest of the transport system. In some cases it may be justified to perform sensitivity tests regarding e.g. the distribution of trip purposes (affects the travel time costs), the vehicle mix (affects vehicle costs) or the life span of the investment (affects the salvage value).

A purely ‘mechanical’ sensitivity analysis (varying the factors ± X%) is usually not appropriate. For instance, an increase in the budget may well be likely whereas its decrease may not be probable. It should therefore be the goal to estimate likely ranges of variation and to assess the socio-economic feasibility of the project within them.

***Case 11*** ***The results of the sensitivity analysis of the cost-benefit calculation of an urban rail line project.***

| | Alternative 1 | |
|---|---|---|
| | Immediate impacts | Urban form included |
| *Benefit-cost ratio of the base calculation* | *1.10* | *1.70* |
| **Benefit-cost ratio, in case of** | | |
| Operation costs of train traffic at the 2001 level | 0.47 | 1.06 |
| Adding one train unit | 0.97 | 1.56 |
| Deducting one train unit | 1.23 | 1.82 |
| Adding one regional bus line | 0.97 | 1.56 |
| Omitting the stopping of K trains in Pukinmäki | 1.13 | 1.72 |
| Ignoring the terminal cost savings | 1.04 | 1.63 |
| Including the Do Min. investment costs (€6m) | 0.98 | 1.50 |
| Opening postponed until 2010 | 1.21 | 1.80 |
| Opening postponed until 2015 | 1,30 | 1.89 |

### 4.3.11 Documentation and Presentation of the Calculation

A cost-benefit calculation must be documented in sufficient detail so that an outside expert will be able to update the calculation, if the calculation values, unit costs or impact assessments, on which the calculation is based, are changed. This requires the documentation of at least the following:

- the demand for transport used in the calculation;
- the unit values used and their possible applications;
- benefits and costs by cost factor, vehicle group and user group in the alternatives compared and in the present and forecast situation; and,
- the accumulation of benefits and costs during the calculation period.

The nature of the document is technical and its purpose is to supplement the planning and design documents and impact assessment reports. The cost-benefit calculation document may be a memo of a few pages or a part of the assessment report where the calculation is described in sufficient detail.

In a separate assessment report or an engineering document the cost-benefit calculation needs to be presented so that the following issues are clearly brought up:

- the investment cost used, both in absolute terms and as the present value;
- the benefits and costs of the project, itemized and discounted to the base year; and,
- the socio-economic feasibility indicators of the project.

In some cases it may be enlightening to present the accumulation of the benefits and costs year by year or other detailed information that is normally included in the documentation of the cost-benefit calculation only.

***Case 12*** ***The core issues in documenting the cost-benefit calculation of a road project.***

The impacts on transport costs have been calculated over the whole network using the new unit costs issued by the Road Administration in 2000. Although the method, based on an EMME/2 network assignment, takes into account the changes in congestion at the link level, it is not able to capture e.g. the changes in costs occurring at individual junctions. A more detailed calculation would require handling the delays in the junctions of the present Highway 12 with junction calculation models or a simulation model.

| | Basic Network in 2010, €m/a | Ring Road Network in 2010, €m/a | *Difference, €m/a* |
|---|---|---|---|
| Vehicle costs, light vehicles | 141.2 | 140.7 | *-0.5* |
| Vehicle costs, heavy vehicles | 86.2 | 86.0 | *-0.2* |
| Time costs, light vehicles | 233.5 | 226.4 | *-7.2* |
| Time costs, heavy vehicles | 51.1 | 50.2 | *-0.9* |
| Accident costs | 59.5 | 57.8 | *-1.7* |
| Env. costs of fuel use | 25.0 | 24.4 | *-0.6* |
| **Total** | **596.6** | **585.5** | ***-11.1*** |

| | Basic Network in 2020, €m/a | Ring Road Network in 2020, €m/a | *Difference, €m/a* |
|---|---|---|---|
| Vehicle costs, light vehicles | 161.1 | 160.3 | *-0.8* |
| Vehicle costs, heavy vehicles | 107.6 | 107.2 | *-0.4* |
| Time costs, light vehicles | 268.2 | 259.0 | *-9.3* |
| Time costs, heavy vehicles | 64.3 | 63.0 | *-1.3* |
| Accident costs | 67.9 | 65.9 | *-2.0* |
| Env. costs of fuel use | 29.2 | 28.5 | *-0.7* |
| **Total** | **698.3** | **683.9** | ***-14.4*** |

The provisional cost-benefit calculation has been made using the following assumptions and choices:

- The southern ring road will be opened in 2010.
- The construction costs will be €111m (Soramäki - Highway 4) and will take two years per phase (e.g. the scheme will be implemented in two stages which will take 2+2 years).
- The calculation period is 30 years after which the salvage value of the investment will be 25%.
- The discount rate is 5%.
- The traffic growth will be linear from 2000 to 2020. After 2020, the growth of the benefits will be 1%/a, i.e. a little less than half of what it will be for 2010-2020.
- The maintenance costs of the investment will be €0.5m annually (ca. 0.5% of the investment), which have been deducted from the transport economic savings.
- The reference case is the present network with some with some complements (the Basic Network 2020).

The benefit-cost ratio for the whole southern ring road (Soramäki - Highway 4) is, on the conditions presented, 1.9.

## 4.4 Effectiveness Assessment

- **Only part of the impacts of the project can be monetized and included in a cost-benefit calculation. Therefore, the impacts need to be considered as a whole in relation to transport political objectives. This kind of overall assessment is called the effectiveness assessment of the project.**
- **Effectiveness assessment is an expert task based on the various studies of the impacts of the project, the cost-benefit calculation and also the views of different experts.**
- **The effectiveness of the project is described, verbally and justifying the positions taken, from different viewpoints such as daily mobility, business life, regional development, the environment, traffic safety and economy.**
- **Plus or minus signs or colours may be used in summarizing the results of an effectiveness assessment. The connections to the cost-benefit calculation are mentioned. The summary may also be verbal.**

### 4.4.1 The Purpose of Effectiveness Assessment

The benefit-cost ratio covers only part of the impacts of the project and can, in its seeming accuracy, give a misleading picture about the socio-economic feasibility of the project. Therefore, the impacts of the project must be considered as a whole, of which the cost-benefit calculation is one part.

The overall consideration of the impacts is an expert task based on the impact studies of the project and on the expert views collected during the engineering process. The impacts are assessed from different viewpoints so that the areas that are likely to be of the greatest interest in decision-making are covered. It ensues from the nature of this type of assessment that the results can vary depending on the expert who performs the task. It is therefore essential that the assessment includes justification for the positions taken.

Assessing the project from different viewpoints gives a more diverse picture of the impacts of the project and their significance than the cost-benefit calculation. Based on the overall assessment, it may also be evaluated to which extent the cost-benefit calculation captures the impacts of the project and what impacts are excluded.

### 4.4.2 Contents of the Effectiveness Assessment

Effectiveness assessment requires an argumentative verbal description of what kind of impacts and impact mechanisms the project will give rise to when looked at from different viewpoints. The assessment concentrates primarily on the difference between the Investment Alternative and the Reference Alternative, just like the cost-benefit calculation. In addition, the changes in regard to the present situation may be assessed.

The effectiveness assessment comprises the following areas: people’s daily mobility, business life, regional development, the environment, traffic safety and economy. Components and issues related to each area are presented in Table 3. The contents of the effectiveness assessment may vary somewhat. What is important is that all the relevant positive and negative impacts are considered.

*Table 3. The viewpoints to be employed in effectiveness assessment, and related components and issues to be assessed.*

| Viewpoint | Components | Issues to be assessed |
|---|---|---|
| **Daily Mobility** | Commuter traffic | Conditions for the different transport modes and travel chains during peak hour |
| | Safety of ways to school | General conditions for pedestrians and cyclists, quality of stations and stops of public transport and the related pedestrian and cycle paths |
| | Access to basic services | Connections to population centres and to services by different modes of transport |
| | Mobility of different population groups | Accessibility of the transport system, mobility of non-car owners |
| | Speed of travel | Travel times, speed levels |
| | Leisure time mobility | Conditions for the different transport modes and chains in evening and weekend traffic |
| **Business life** | International transport | Connections to ports, border crossings and airports |
| | | Connections of international passenger and goods transport |
| | Reliability and punctuality of transport operations | Predictability of journey times and the incident sensitivity of transport connections |
| | Cost effectiveness of transport operations | Capacity and maximum permitted load of routes |
| | Needs of tourism | Conditions for the different transport modes and chains from the tourist's viewpoint |
| | Speed of transport | Transport times, speed levels |
| **Regional development** | Transport problems related to regional development | Problems in the transport system that are of significance regarding the regional development plans and goals. |
| | Infrastructure and land use in various areas | The compatibility or otherwise of land use and the transport system |
| | Land use structure | Characteristics of land use structure (e.g. sprawling or dense) |
| | Strengths of regions | Relation of transport connections to the strengths (e.g. the natural environment, natural resources, business activities) |
| | Attractivity of regions | Significance of transport connections as an attraction factor |
| **Environment** | Living environment | Noise, vibration and emissions from transport |
| | | Barrier effect of transport infrastructure |
| | Natural environment | Soil, ground- and surface water, biodiversity, climate, environmental risks |
| | Land- and townscape | The impact of infrastructure and traffic on land- and townscape and their role as part thereof |
| | Cultural heritage | The impact of infrastructure and traffic on culturally valuable sites and the access to them |
| **Safety and security** | Traffic safety | Number of accidents, fatalities and injuries; accident risk |
| | Security | Risk of being subjected to violence |
| **Economy** | Infrastructure economy | Socio-economic feasibility of the project, maintenance costs of the infrastructure |
| | Transport operations | Transport operating costs; efficiency and profitability of operations |
| | Finances | Transport costs, travel costs |
| | Households | Mobility costs, time spent in traffic |

*Case 13* ***Assessment of the impacts of a motorway scheme on the conditions of public transport as well as pedestrian and bicycle traffic.***

**If the project will not be implemented, coach traffic, alongside with car traffic, will continue to suffer from level-of-service problems.**

**If it will be, the impacts will not be great, but the general objectives concerning public transport or the slow modes will not be particularly promoted, either.**

At present, there is a large volume of long-distance coach traffic on the highway. For coaches, the predictability of journey times is important but poor in the present situation. Also, it is difficult for coaches to re-enter the traffic flow from stops because of the heavy traffic.

The significant improvement of the road would benefit public transport by increasing the smoothness of the traffic flow. However, the predictability of journey times would not markedly improve. From the viewpoint of long-distance coach transport, the motorway alternative is clearly the best one. On the other hand, constructing the motorway would favour coaches in their competition with trains.

As regards pedestrian and bicycle traffic, there are no particular problems with the present road. The heavy traffic in itself does form a barrier and also makes it difficult to move on the verge where there is no separate path for pedestrians and cyclists. Significantly improving the road would include enhancing the conditions of pedestrians and cyclists by building underpasses and new paths. The motorway alternative would improve the conditions by significantly reducing the traffic volume of the present road, and that alternative also includes other measures facilitating pedestrian and bicycle traffic. The differences of the different alternatives are, however, not significant from this viewpoint.

**Summary and the relationship with the cost-benefit calculation:**

| | **The present road** | **Significant improvement** | **Motorway** |
|---|---|---|---|
| **Conditions for pedestrians and cyclists** | Increasing problems because of growing traffic. | Barrier effects by grade-separated junctions etc. On the other hand, underpasses and new paths. | Improves conditions on the old road. Plans include 13km of paths. |
| **Conditions for public transport** | Low travel speed and the road's incident sensitivity cause unpredictable delays. | Reliability poorer than that of a motorway. Problems with timetables may continue. | Conditions will improve. Competitiveness of long-distance rail traffic may be hampered. |
| **Oveall assessment** | **Slightly negative.** | **No clear direction.** | **Positive to some extent.** |
| **Costs with no corresponding monetary benefits** | | Arrangements for pedestrian and bicycle traffic. | Arrangements for the slow modes worth  2.5m - 3.3m, part of which should be implemented also in the Reference Alternative. |
| **Relationship with the profitability calculation** | Time and vehicle costs include coaches. Difficult to precisely establish the distribution of the benefits between passengers and transport operators. On the other hand, the costs of the measures improving the smoothness of public transport are included. The calculation excludes the benefits and disbenefits to pedestrian and bicycle traffic. | | |

### 4.4.3 Documentation and Presentation of the Effectiveness Assessment

An argumentative verbal description serves also as a document of the expert evaluation of the effectiveness of the project (cf. Case 13 above). If a certain part of the assessment is directly based on a written source or an expert statement, the appropriate reference is provided. This enables a distinction to be made between the conclusions of the assessor him-/herself and those based on separate studies.

A summary is drawn up of the results of the effectiveness assessment to give an overall picture of the most important impacts of the project and their direction from various viewpoints. The summary also needs to bring out to which extent the impacts have been considered in a possible cost-benefit calculation.

***Case 14 Summary of the effectiveness analysis of an urban rail line project.***

| | **Change from the present situation** | **Difference from the Reference Alternative** | **Covered in the cost-benefit calculation** |
|---|---|---|---|
| **Daily mobility** | | | |
| Frequency and speed of public transport services | ++ | ++ | Entirely |
| Punctuality and regularity of public transport | ++ | ++ | Not at all |
| Other level-of-service factors of public transport | ++ | ++ | Not at all |
| Congestion of vehicle traffic | -- | + | Entirely |
| Conditions for pedestrians & cyclists | ++ | 0 | Not at all |
| **Business life** | 0 | 0 | Not at all |
| **Regional development** | | | |
| Prerequisites for the development of different regions | ++ | ++ | Not at all |
| Land use structure | ? | + | Not at all |
| **Environment** | | | |
| Noise and emissions from road traffic | + | + | Entirely |
| Energy consumption by transport | + | + | Entirely |
| Impacts on the natural environment | ? | + | Not at all |
| **Traffic safety** | + | + | Entirely |
| **Economy** | | | |
| Costs of public transport | - | - | Entirely |
| Infrastructure maintenance costs | - | -- | Entirely |
| Benefit-cost ratio of project | | 2.1 | |

| | |
|---|---|
| ++ | Change or difference significantly positive |
| + | Positive but not significant in relation to the scale of the project |
| 0 | No clear change or difference |
| ? | Direction of change or difference not known |
| - | Negative but not significant in relation to the scale of the project |
| -- | Significantly negative |

***Case 15 Summary of the effectiveness analysis of a main road project.***

| | Change from the present situation | Difference from the Reference Alternative | Covered in the cost-benefit calculation |
|---|---|---|---|
| **Daily mobility** | | | |
| Smoothness of long-distance car traffic | 0 | ++ | Entirely |
| Smoothness of local car traffic | - | - | Entirely |
| Conditions for pedestrians & cyclists and public transport | ++ | + | Not at all |
| **Business life** | | | |
| Reliability and punctuality of road transport | ? | + | Partially |
| Needs of tourism | ? | + | Partially |
| **Regional development** | | | |
| Regional development objectives | ? | ++ | Not at all |
| Land use structure | ? | - | 1 |
| **Environment** | | | |
| Noise and emissions from road traffic | - | + | Entirely |
| Impacts on the natural environment | -- | -- | Not at all |
| **Traffic safety** | + | ++ | Entirely |
| **Economy** | | | |
| Transport costs | - | + | Almost entirely |
| Maintenance costs of the road | - | -- | Entirely |
| Benefit-cost ratio of the project | | **1.8** | |

| | |
|---|---|
| ++ | Change or difference significantly positive |
| + | Positive but not significant in relation to the scale of the project |
| 0 | No clear change or difference |
| ? | Direction of change or difference not known |
| - | Negative but not significant in relation to the scale of the project |
| -- | Significantly negative |

***Case 16*** ***Summary of the effectiveness analysis of a waterway project.***

| | Change from the present situation | Difference from the Reference Alternative | Covered in the cost-benefit calculation |
|---|---|---|---|
| **Daily mobility** | **0** | **0** | Not at all |
| **Business life** | | | |
| Conditions for international transport | ++ | ++ | Partially |
| Cost effectiveness of transport | ++ | ++ | Partially |
| **Regional development** | | | |
| Development of port operations | + | + | Not at all |
| **Environment** | | | |
| Negative impacts on the aquatic environment during construction | -- | -- | Not at all |
| Long-term negative impacts on the aquatic environment | **0** | **0** | Not at all |
| Emissions from vessel traffic | - | + | Entirely |
| **Traffic safety** | **0** | **0** | Not at all |
| **Economy** | | | |
| Transport costs | ++ | ++ | Entirely |
| Maintenance costs of the waterway | + | + | Entirely |
| Optimizing the ice-breaking operations | **0** | ++ | Not at all |
| Benefit-cost ratio of the project | | **2.6** | |

| | |
|---|---|
| ++ | Change or difference significantly positive |
| + | Positive but not significant in relation to the scale of the project |
| 0 | No clear change or difference |
| ? | Direction of change or difference not known |
| - | Negative but not significant in relation to the scale of the project |
| -- | Significantly negative |

## 4.5 Feasibility Assessment

- **Feasibility assessment[1] provides information on factors affecting the implementation maturity and feasibility of the project.**
- **Factors to be assessed include the planning and design status, permit processes, funding prospects, financial, technical and transport operating risks, the possibility to implement the project in stages and impacts that will occur during construction.**

The purpose of feasibility assessment is to highlight factors that are important in deciding on the implementation of the project but are not covered by the cost-benefit calculation or the effectiveness assessment. These include e.g. the following issues:

- *Planning and design status*—the current stage of the planning/design process, the duration of the process as well as the land use planning situation and its significance for the project are presented.
- Different *permit processes* including possibilities of complaint stipulated by road, waterways, environmental and land use legislation may be related to the project.
- *Funding possibilities* from outside the state budget, such as EU support, municipal participation and private funding may be addressed.
- *Financial risks* may be created by certain special characteristics of the project rendering the cost estimate more uncertain than usually is the case (e.g. poor soil, urban conditions, tunnel construction and lack of mass balance).
- *Technical risks* can be present if the project includes technology or solutions (e.g. tunnels) whose implementation or use involves risks that are higher than usual.
- *Transport operating risks*—it may be relevant for the feasibility or timing of the project what are the transport operators' possibilities of, and the risks involved in, providing services enabled by the project, such as raising the frequency of public transport services, increasing inland waterway transport or expanding high-speed train transport.
- *Implementation in stages* may reduce risks related to the uncertainty of the future.
- *Impacts during construction* can include significant delays for traffic, and this may be one hindrance for the implementation of the project. Any significant impacts on the environment and land use during construction must also be presented.

The above factors affect in part he project's implementation maturity (when it can be implemented) and feasibility (whether it can). Assessing the implementation maturity belongs to the tasks of those assessing the project. As regards the feasibility of the project, however, the assessment is purely descriptive, i.e. the factors affecting feasibility are raised but their significance for the implementation decision is not anticipated.

[1] The term "*socio-economic feasibility*" is used in this report when referring to the impacts of the project and their distribution. Feasibility assessment deals with other aspects of feasibility in the general sense of the word.

***Case 17 Assessment of the factors affecting the feasibility of a motorway project.***

**Planning and design status, permit processes.** The final engineering of the stretch from Muurla to Lohja are completed in September 2001 and the documents are sent to the administrative process. A positive decision requires that the revision of the regional plan of Varsinais-Suomi has been approved first. Subsequently, the process leading to the legal force of the final engineering may begin. It is estimated that completing this process, including the handling of any complaints, will take two years at most. Thus the whole stretch from Muurla to Lohjanharju will have a legally valid final engineering no later than in early 2004. In the promptest alternative, the plan could be validated in the autumn of 2002.

**Cost risks.** Unit prices from motorway construction projects underway have been utilized in the calculation. The greatest risk is related to the costs of the seven tunnels of the project and significant surplus land masses. The cost level is high especially east of the Nummi interchange because of several consecutive tunnels and extensive groundwater protection measures.

The mass use of the scheme will be improved by adjusting the vertical alignment of the road, soil stabilization, landscaping, high noise banks and by using other means of road design. No use has so far been found for the large amounts of surplus rock and earth material.

The market situation of earth and tunnel construction may affect the tenders that will be received, if several significant projects of the same type are ongoing simultaneously. Such projects are e.g. the transport connections of the Vuosaari harbour and the Centre Tunnel of Helsinki.

**Implementation in stages.** The three parts of the project can be organized to be implemented in stages in the following order:

1. Lohja–Lohjanharju.
2. Lahnajärvi–Lohja.
3. Muurla–Lahnajärvi.

**Technical risks.** There are demanding technical solutions required by the tunnels and mass balance of the project. These may affect the costs. In technical terms, the problems can be handled.

**Impacts during construction.** The negative impacts during construction will be significant but, in relation to the scale of the scheme, reasonable, whereas improving the existing roads would have significant negative impacts on traffic.

# 5 REPORTING AND SUMMARIZING

- **The assessment of a transport infrastructure project is documented in sufficient detail so as to make it transparent and updatable. The document may be part of the project documentation or a separate report or memo.**
- **A 1–4-page summary is drawn up of the contents and results of the assessment. The first page acts as an independent abstract.**

## 5.1 Documentation and Reporting

The assessment needs to be documented in such detail that an outside expert will be able to update it. This is important because large projects are included in plans for many years during which the calculation values, unit values, forecasts and transport policy objectives may change. The assessment must be updatable in order to make it comparable with projects whose engineering and assessment have been completed at different times. The document also needs to allow the checking of whether the assessment has been carried out according to the guidelines given.

The most important parts of the documentation are the sufficiently detailed description of the cost-benefit calculation (see section 4.3.11) and the bases of the effectiveness assessment (see 4.4.3). It also needs to include references to the information sources used as well as the justification for and description of possible post-processing or interpretation of the information gained from these sources. If the assessment is published as a separate report, the documentation is included therein. If only a summary is published of the assessment or its results are contained in the project documentation, a separate memo is drawn up as the assessment document.

## 5.2 The Summary of the Assessment

The core contents of the assessment of a transport infrastructure project are lastly to be collected into a concise project card wherein the project, its impacts, the cost-benefit calculation, the achievement of goals and the feasibility of the project are presented. The project card may consist of one, two or four pages. In all cases, page one is similar, an independent abstract covering the purpose, contents and impacts of the project and presenting the following issues:

- background, contents, costs and funding of the project;
- the implementation maturity of the project as regards planning and design;
- the most significant impacts of the project and its benefit-cost ratio; and,
- where to obtain further information and, if necessary, the documentation of the assessment.

A two-page project card includes a map in addition to the first page. In a four-page card, the project and its background and impacts are described somewhat more elaborately. Upon inclusion of a project in the state budget, the contents, impacts, costs and funding are described even more concisely than in a one-page project card. Examples of project cards of different extent are presented in *Appendix 5*.

# 6 APPLYING THE GUIDELINES

- **In assessing transport infrastructure projects, it is more important to comply with the spirit of the Guidelines than with their letter. A single project is always unique and its assessment may entail adaptive application of the Guidelines.**
- **The result of a carefully made cost-benefit calculation expresses the feasibility of the project only from viewpoint of socio-economic efficiency. Assessing the effectiveness of the project from different points of view gives broader answers to questions relevant in decision-making.**

The Guidelines for Assessing Transport Infrastructure Projects are meant to guide assessment in a general way. Their main purpose is to ensure that the following points are realized in the assessment of transport infrastructure projects proposed for action and financial plans, investment programmes or budgets of the Ministry of Transport and Communications:

- the same concepts and principles are applied;
- the same calculation formulas are used (or the justification for deviating from them is presented);
- the impacts of the projects are assessed as wholes from such viewpoints that jointly cover the different areas of transport policy; and,
- similar ways of presentation and documentation are used in presenting the results and ensuring updatability.

More detailed instructions and methods are needed in making the actual assessment. The Road, Rail and Maritime Administrations are responsible for developing and maintaining these. The more detailed instructions must fall in line with these Guidelines.

Most transport infrastructure projects are unique. Thus an assessment is also always a unique study with both similarities with and differences from the assessments of other projects. A project may possess features that have not been taken into account in the Guidelines or in the more detailed instructions; these cannot, in practice, be so detailed as to make case-specific deliberation and adaptation unnecessary. And although the assessment framework, main principles, calculation values and unit values presented in the Guidelines are to be applied in all assessments, differences may exist between projects as regards scoping and the extent and level of detail of the assessment of the impacts. This is why documenting the assessment and justifying the adaptations and conclusions made are very important. Every well made, justified and documented transport infrastructure project assessment contributes to a sound assessment practice.

The purpose of the assessment of a transport infrastructure project is to generate information on issues that are relevant in decision-making. An assessment carried out carefully according to the Guidelines and other relevant instructions will ‘open up’ the purpose, contents and impacts of a project in a broad and argumentative manner. A cost-benefit calculation drawn up according to the Guidelines tells about the socio-economic feasibility of the project in a comparable way, and the effectiveness assessment describes the impacts of the project from several different viewpoints.

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## APPENDIX 1. TERMS AND CONCEPTS USED IN THE GUIDELINES

**Benefit-cost ratio** The ratio of benefits to costs. Either (1) the ratio of the present value of the annual benefits to the sum of the present values of the investment and the annual costs (gross value) or (2) the ratio of the present value of the net benefits to the investment costs (net value). The end result of the cost-benefit calculation of a transport infrastructure project is a net benefit-cost ratio.

**Compound impact** Impact of one field of business or activity to another activity.

**Consumer surplus** The difference between the consumer's willingness to pay and the actual price paid. The net benefit of the consumer.

**Cost** Monetary or monetized harm or disbenefit (e.g. an investment cost, vehicle cost, travel time cost, emission cost).

**Cost-benefit analysis** Analytical methodology measuring the changes in the well-being of consumers. Takes into account the benefits and costs of all parties, including the externalities.

**Cost-benefit calculation** A calculation of the monetized benefits and costs and their ratio to the investment cost.

**Discount rate** The interest rate used in discounting. Illustrates society's temporal preference.

**Discounting** Calculating the present value (at the time under consideration) of a future benefit or cost.

**Expansion investment** An investment to increase the capacity of a road, rail line or waterway or to raise its standard. Improving the alignment of a road, deepening a channel, building a by-pass track and installing safety equipment are examples of expansion investments.

**Externality** A positive or negative side effect of production or consumption not taken into account by the agent creating the effect. The part of society that is subject to an externality is not involved in the activity that creates it.

**Funding** Acquiring funds for implementing a project.

**Interest** The price of or returns on money.

**Investment** Money invested. A long-term cost which is expected to yield income or other benefits over a long period.

**Life span** The estimated useful life of an investment taking into account its eventually becoming economically and technically outdated.

**Monetization** Assessing an impact with no market price in terms of money.

**New investment** An investment to improve the level of service of a transport network. Building a second carriageway, an additional track or an altogether new route are examples of new investments.

**Present value** The value of future benefits or costs at the time of consideration. The present value is calculated by discounting the future benefits and costs. The greater the discount rate, the smaller the present value.

**Producer surplus** The difference between the price that a producer (e.g. a transport operator) gets in the market and the least price at which the producer is willing to sell.

**Replacement investment** An investment to restore or maintain the trafficability of transport infrastructure. Renovation of infrastructure and replacing infrastructure-related equipment are typical replacement investments.

**Salvage value** The estimated value of an investment at the end of the calculation period. It may also be negative; e.g. a bridge may possible need to be subsequently demolished.

**Sensitivity analysis** Analysing the costs and benefits of a project when different uncertain factors change.

**Surplus** The difference between benefits and costs, the net benefit.

**Transport Administrations** Finnish Road Administration, Finnish Rail Administration and Finnish Maritime Administration.

**Transport infrastructure investment** An investment in a road, a railway or a waterway.

**Transport operating costs** The costs brought about by the purchase and operation of vehicles plus the related administrative and control costs.

**Unit cost** Cost per a unit of performance.

**Willingness to pay** The willingness of a consumer to pay for a good or a service. In order that a purchase decision is made the willingness to pay must be equal to or greater than the price asked or the costs perceived.

## APPENDIX 2. CALCULATION FORMULAS FOR INDICATORS

The benefits and costs generated in different years are made commensurable by **discounting** them to the base year (year 0) using a discount rate. Presently, the interest rate to be used is 5%; hence the constant 1.05 in the formulas.

The present value of a benefit item, $\mathbf{H_P}$, or of a cost item, $\mathbf{K_P}$, is derived by discounting and summing up the benefit (cost) items $\mathbf{H_t}$ ($\mathbf{K_t}$) created in the years 1 to 30 as follows:

(1) $$H_P, K_p = \sum_{t=1}^{30} \frac{1}{1.05^t} (H_t, K_t)$$

Correspondingly, an interest is calculated for the investment cost for the construction period. The present value $\mathbf{I_P}$ of the investment cost **I** is calculated by adding up the costs incurred in the years –n to 0 with the related interest items $\mathbf{I_t}$ as follows:

(2) $$I_P = \sum_{-n}^{0} \frac{1}{1.05^t} (I_t)$$

Part of the investment costs may be incurred only after the base year, i.e. the year of opening the route to traffic. They are discounted to the base year using formula (1).

The **salvage value** is a fixed share of the investment cost and based on an assumption of the average life span of the investment. The salvage value is, as a rule, no more than 25% of the investment, i.e. the life span is not expected to exceed 40 years. The depreciation is assumed to take place linearly. The salvage value is discounted to the base year and taken into account in the cost-benefit calculation as a benefit. Salvage value **J** is thus a benefit occurring in year 30, and its present value $\mathbf{J_p}$ is arrived at by discounting:

(3) $$J_P = \frac{1}{1.05^{30}} (J)$$

The basic indicator for socio-economic feasibility is the net **benefit-cost ratio** (H/K) which means the ratio of the present value of the net benefits to the present value of the investment cost:

(4) $$H / K = \frac{H_p + J_p - K_p}{I_p}$$

In order for the project to be socio-economically feasible, the benefit-cost ratio must be greater than or equal to one.

The (present) **capital value**, **NA** is derived by discounting the benefits and costs generated in different years to the base year and calculating the remainder:

$$(5) \qquad NA = H_p + J_p - K_p - I_p$$

The capital value shows the net benefit (or cost) of the project in the base year. The project fulfils the basic criterion of socio-economic feasibility if the NA exceeds zero. This implies that the monetary value for society of the investment is greater than the returns on the investment cost if it were deposited in a bank for the calculation period with an interest rate equal to the discount rate.

The **internal rate of return** means the annual 'returns' on the invested capital. It can be numerically calculated from the following equation:

$$(6) \qquad \sum_{-m}^{n} \frac{1}{(1+i)^t}(H_t + J_n - K_t - I_t) = NA = 0$$

where the symbols are the same as above and the interest rate to be determined is **i*100%**. In practice, the easiest way to establish the approximate internal rate of return is to try different values. The internal rate of return means the rate of return of an investment and thus it tells more of the viability of the investment than the capital value. The investment under consideration can be deemed as feasible if the internal rate of return exceeds the rate of return required of the investment.

The purpose of the **annuity method** is to calculate the average annual net returns on the investment, $\mathbf{P_a}$. The average annual cost $\mathbf{K_t}$ and the remainder of the investment cost and salvage value, converted into equal annual sums, are deducted from the average annual benefit $\mathbf{H_t}$:

$$(7) \qquad P_a = H_t - K_t - \frac{0.05(1.05)^{30}}{(1.05)^{30} - 1}(I - J)$$

The result is the yearly benefit or cost from the investment. The socio-economic feasibility criterion is fulfilled when $\mathbf{P_a}$ is greater than zero. If the annual benefits and disbenefits vary largely in different years, this method gives a more misleading picture of the investment than e.g. the capital value.

The **one-year rate of return**, **ta**, is the ratio of the benefits from the investment in a chosen year, $\mathbf{T_n}$, to the investment cost, **I**:

$$(8) \qquad ta = \frac{H_n}{I}$$

The rate of return of a single year can only be used to supplement other socio-economic feasibility indicators. It is quite suitable for e.g. comparing different route alignments. The fulfilment of the socio-economic feasibility criterion cannot, however, be assessed based on the one-year rate of return.

## APPENDIX 3. THE PREVAILING PRACTICE CONCERNING THE SCOPING OF THE ASSESSMENT IN DIFFERENT PROJECT TYPES

The assessment of a transport infrastructure project cannot be scoped based on the project type. Thus, the general guideline is that all relevant impacts be considered (see section 4.2). In practice, however, there are certain basic limitations brought about by the nature of project types, the undeveloped state of calculation methods and the need to ensure the comparability of projects within one mode of transport. These restrictions are described in Table 4 and justified below

.

*Table 4. The prevailing practice in scoping the assessment of different types of transport infrastructure projects.*

| Project type | Transport impacts of land use changes | Assessment of changes in modal split | Impacts on the rest of the network | Congestion of road traffic | Level-of-service factors (apart from travel time) |
|---|---|---|---|---|---|
| National road projects | * **No, S** | * **No, S** | ** **Yes** | *** **Yes** | * **No, S** |
| Urban road projects | * **No, S** | * **No, S** | *** **Yes** | *** **Yes** | * **No, S** |
| National rail projects | ** **No, S** | ** **Sometimes, S** | ** **Yes** | * **Sometimes** | ** **Sometimes, S** |
| Urban rail projects | *** **Sometimes, S** | ** **Yes** | ** **Yes** | ** **Yes** | ** **Yes, S** |
| Waterway projects | * **Sometimes, S** | * **Sometimes, S** | * **Sometimes, S** | * **No, S** | * **No, S** |
| System projects; ones related to new land use | **(*) **Sometimes, S** | *(**) **Yes** | **(*) **Yes** | **(*) **Yes** | ** **Sometimes, S** |

*Key*

| | |
|---|---|
| * | impact usually minor |
| ** | often has an impact |
| *** | impact often central |
| **No** | usually not included in actual assessment |
| **Some-times** | can be relevant and is therefore usually included in actual assessment; inclusion is separately justified |
| **Yes** | is usually relevant and thus included in actual assessment |
| **S** | if included in actual assessment, to be excluded in a sensitivity test; if excluded from actual assessment, may be included in a sensitivity test |

*National road projects* affect mainly long-distance traffic, and thus their impact is wide but relatively slight. The average travel time saving is typically some minutes whereas the average journey time may exceed an hour. Therefore, the impacts on land use and modal split are usually not significant. A project is often triggered by a decrease in the smoothness of the flow of traffic, and the anti-congestion impact is usually an important part of the effect of the project.

*Urban road projects* affect primarily local and regional traffic, which makes their sphere of influence narrower but the impact stronger, in relative terms, than in national road projects. But as with national projects, the starting point is usually not related to the development of land use structure or the modal split but the solving of congestion, safety and environmental problems.

*National rail projects* can, at their best, decrease travel times dozens of minutes. Introduction of faster rolling stock may be related to such a project. The impacts are felt the most strongly in cities with a railway station and more mildly elsewhere. The speeding up of rail transport may affect modal split.

*Urban rail projects* are usually motivated by goals concerning the urban form or modal split. The impacts are usually significant in a relatively restricted area, which creates pressures and opportunities for the development of land use. An urban rail projects may be a central part in the development of land use e.g. in the context of master planning. The improvement of public transport connections together with land use changes may cause locally significant changes in the volumes and congestion of vehicle traffic. Urban rail projects generally have a marked impact on the punctuality and regularity as well as the waiting and interchange conditions of public transport and these have an impact on the qualitative level of service, not only on travel time.

*Waterway projects* are usually about the upgrading of present channels and enable the increase of vessel size and cargo load. This usually affects the costs of vessel transport but may sometimes have an impact on the development of industrial facilities or harbours and further on ground transport. Large canal projects are exceptions as they may have large-scale impacts on e.g. the location of industry, on other modes of transport and on land use.

*Intermodal system projects* are unique and may affect several transport modes as well as the development of land use.

## APPENDIX 4. THE UNIT VALUES TO BE USED IN COST-BENEFIT CALCULATIONS

### Vehicle, Transport Operating and Vessel Costs

The unit values for **vehicle costs** (Table 5) are used in assessing road projects and also other projects if they affect road traffic flows. The unit costs used in the cost-benefit calculation of a transport infrastructure project must not contain taxes (the cost for a light vehicle is 9.6 cents/km). In predictive transport models, however, the tax-containing total costs are to be used.

No case-specific index adjustments may be made to the unit values.

*Table 5. Unit values for vehicle costs in cents/km (year 2000).*

| **Vehicle type** | **Vehicle costs** | ***Total costs*** | | | |
|---|---|---|---|---|---|
| | | ***Road transport specific taxes*** | ***Other costs*** | ***VAT*** | ***Total*** |
| Car | 8.7 | *7.9* | *4.0* | *3.2* | *23.9* |
| Van | 17.7 | *6.6* | - | *5.3* | *29.6* |
| **Average light vehicle** | **9.6** | ***7.9*** | ***3.7*** | ***3.5*** | ***24.7*** |
| Bus | 52.5 | *9.3* | - | *13.8* | *75.5* |
| Lorry | 57.4 | *14.1* | - | *15.4* | *87.0* |
| **Average heavy vehicle** | **56.5** | ***13.1*** | - | ***15.1*** | ***84.8*** |

The confirmed values and methods are not, however applicable to all projects as such. The unit values do not reflect correctly impacts e.g. on the **operating costs of public transport in an urban area** or on **ticket revenues**. In such cases, valuation has to be performed case by case utilizing statistics and expert knowledge concerning the urban area in question.

No confirmed unit values exist for valuing changes in the **operating costs** and **ticket and freight revenues of rail transport**. The information needed to establish them contains business secrets of transport operators. Estimation has to be done separately in each case with the help of expert estimates by the Rail Administration.

There is a separate guide for estimating the **vessel costs in maritime transport**. The costs vary by vessel type and depend on the size of both the vessel and its cargo load.

**Further information and more detailed instructions can be obtained from the following publications:**

*Unit Costs in Road Transport 2000.* Finnish Road Administration 2001. (In Finnish.)

*Vessel costs 2001.* Publications of the Finnish Maritime Administration 4/2001. (In Finnish)

## Travel Time Costs

The unit values for travel time costs in road traffic (Table 6) are used in the assessment of rail and waterway projects in addition to road schemes. The distribution of trip purposes may for justified reasons vary by project. Moreover, in public transport projects there are grounds (although no confirmed guidelines) for using differentiated values of travel time for e.g. walking and waiting. The average value per hour of travel time may thus vary by project. In all cases, however, the unit values used must be those confirmed for road traffic.

No case-specific index adjustments may be made to the unit values.

*Table 6. Unit prices for the value of travel time at the 2000 price level.*

| **Vehicle category** | **Trip purpose** | **Average load pass./vehicle** | **Value of time €/hour/ person** | **Value of time €/hour/ vehicle** |
|---|---|---|---|---|
| Passenger cars | Business (11 %)<br>Commuting, personal business (37 %)<br>Leisure (52 %)<br>Average | 1.5<br>1.6<br>2.0<br>1.8 | 24.08<br>4.07<br>4.07<br>5.90 | 36.31<br>6.50<br>8.12<br>10.6 |
| Vans, LGVs | Business (35 %)<br>Commuting, personal business (30 %)<br>Leisure (35 %)<br>Average | 1.5<br>1.6<br>1.9<br>1.7 | 20.08<br>4.07<br>4.07<br>8.93 | 30.12<br>6.50<br>7.72<br>15.19 |
| Average for passenger cars and LGVs | Business (14 %)<br>Commuting, personal business (36 %)<br>Leisure (50 %)<br>Average | 1.5<br>1.6<br>2.0<br>1.8 | 23.70<br>4.07<br>4.07<br>6.17 | 35.54<br>6.49<br>8.12<br>**11.07** |
| Buses | | 1+11 | 6.51 | 77.84 |
| HGVs | | 1.1 | 17.31 | 19.04 |
| Average for buses and HGVs | | | | **26.70** |

**Further information and more detailed instructions can be obtained from the following publications:**

*Unit Costs in Road Transport 2000.* Finnish Road Administration 2001. (In Finnish)

*Public Transport in Project Assessment.* Studies of the Finnish Road Administration 40/2001. (In Finnish with an English abstract)

**Emission Costs**

The unit values to be used in calculating the emission costs from road, rail and maritime transport have been defined by mode (Tables 7 to 13).

No case-specific index adjustments may be made to the unit values.

### *Emission Costs of Road Transport*

*Table 7. The emission costs of road transport by component at the 2000 price level (euros/tonne and cents/vehicle-kilometre).*

| Component | Unit | Urban area | Non-urban area | Average |
|---|---|---|---|---|
| $SO_2$ | €/tonne | 13 421 | 1 994 | 8 322 |
| $NO_x$ | €/tonne | 1 111 | 435 | 734 |
| $PM_{2.5}$ | €/tonne | 201 879 | 6 308 | 103 567 |
| CO | €/tonne | 24 | 1 | 16 |
| Hydrocarbons | €/tonne | 67 | 67 | 67 |
| Greenhouse gases as $CO_2$ equivalents | €/tonne | 32 | 32 | 32 |
| Soiling | cents/vehicle-km | 0.09 | 0.0009 | 0.04 |

*Table 8. Emission costs by performance and by vehicle type at the 2000 price level.*

| Vehicle | Urban area | Non-urban area | Weighted average |
|---|---|---|---|
| | | Cents/vehicle-km | |
| Passenger car, no catalyser | 1.2 | 0.6 | 0.9 |
| Passenger car with catalyser | 0.9 | 0.5 | 0.7 |
| Passenger car, diesel | 4 | 0.7 | 2 |
| Van, no catalyser | 1 | 0.8 | 1 |
| Van with catalyser | 1.0 | 0.7 | 0.9 |
| Van, diesel | 5 | 1.1 | 3 |
| Bus/coach | 12 | 3 | 7 |
| Heavy goods vehicle, no trailer | 12 | 3 | 7 |
| Heavy goods vehicle w. trailer | 13 | 4 | 6 |

### *Emission Costs of Rail Transport*

*Table 9. Emission costs of diesel trains by component at the 2000 price level (euros/tonne and cents/train-kilometre).*

| Component | Unit | Urban area | Non-urban area | Weighted average |
|---|---|---|---|---|
| $SO_2$ | €/tonne | 16 575 | 612 | 3 203 |
| $NO_x$ | €/tonne | 1 622 | 186 | 419 |
| $PM_{2.5}$ | €/tonne | 66 959 | 1 896 | 12 457 |
| CO | €/tonne | 15 | 1 | 3 |
| Hydrocarbons | €/tonne | 236 | 236 | 236 |
| Greenhouse gases as $CO_2$ equivalents | €/tonne | 32 | 32 | 32 |
| Soiling | cents/train-km | 28 | 0.12 | 1.53 |

*Table 10. Emission costs of electric trains by component at the 2000 price level.*

| Component | €/tonne |
|---|---|
| $SO_2$ | 1 037 |
| $NO_x$ | 1 536 |
| $PM_{2.5}$ | 2 094 |
| $CO_2$ | 32 |

*Table 11. The emission costs of diesel and electric trains by performance at the 2000 price level.*

| Performance | Pull | Urban area | Non-urban area | Average* |
|---|---|---|---|---|
| €/1000 gross tonne-km | Electric | - | - | 0.17 |
| (all transport) | Diesel | 6.2 | 0.6 | 0.8 |
| €/1000 passenger-km | Electric | - | - | 0.45 |
| (passenger trains) | Diesel | 38.2 | 3.5 | 5.2 |
| €/1000 tonne-km | Electric | - | - | 0.33 |
| (freight trains) | Diesel | 18.1 | 1.6 | 2.5 |

* Weighted with the shares of electric and diesel-powered transport.

## *Emission costs of maritime transport*

*Table 12.* *Emission costs by component at open sea, coastal routes, inland waterways and ports at the 2000 price level (euros/tonne).*

| Component | Open sea (the Baltic) | Coastal route | Inland waterway | Port |
|---|---|---|---|---|
| CO | 0.4 | 2 | 23 | 19 |
| HC | 137 | 153 | 197 | 148 |
| $NO_x$ | 301 | 397 | 569 | 1 062 |
| Particles | 3 410 | 5 610 | 9 580 | 26 880 |
| $CO_2$ | 32 | 32 | 32 | 32 |
| $SO_2$ | 327 | 547 | 684 | 2 283 |

*Table 13.* *Emission costs by the type of freight vessel by vessel day (24 hours) at the 2000 price level, euros/day.**

| Draught | Power | Open sea (approximate estimate) | | | Coastal route | | | Inland waterway | | | Port | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| m | kW | total cost | w/o climate | climate | total cost | w/o climate | climate | total cost | w/o climate | climate | total cost | w/o climate | climate |
| **Dry bulk vessels** | | | | | | | | | | | | | |
| 8 | 3800 | 2400 | 700 | 1700 | 2700 | 1000 | 1700 | - | - | - | 300 | 200 | 80 |
| 9 | 4900 | 3100 | 900 | 2200 | 3500 | 1300 | 2200 | - | - | - | 400 | 300 | 110 |
| 10 | 6000 | 3800 | 1100 | 2700 | 4300 | 1600 | 2700 | - | - | - | 500 | 400 | 100 |
| 11 | 7100 | 4600 | 1300 | 3200 | 5100 | 1900 | 3200 | - | - | - | 500 | 400 | 100 |
| 12 | 8200 | 5300 | 1500 | 3700 | 5900 | 2200 | 3700 | - | - | - | 600 | 500 | 100 |
| 13 | 9300 | 6000 | 1700 | 4200 | 6700 | 2500 | 4200 | - | - | - | 700 | 500 | 200 |
| 14 | 10400 | 6700 | 1900 | 4700 | 7500 | 2800 | 4700 | - | - | - | 700 | 600 | 200 |
| 15 | 11500 | 7400 | 2100 | 5200 | 8300 | 3100 | 5200 | - | - | - | 800 | 600 | 200 |
| 16 | 12700 | 8100 | 2300 | 5700 | 9100 | 3400 | 5700 | - | - | - | 800 | 600 | 200 |
| **Container vessels** | | | | | | | | | | | | | |
| 6 | 4400 | 2740 | 700 | 2100 | 3000 | 1000 | 2100 | 3500 | 1400 | 2100 | 400 | 300 | 110 |
| 7 | 5100 | 3200 | 900 | 2400 | 3600 | 1300 | 2400 | - | - | - | 400 | 300 | 100 |
| 8 | 8300 | 5330 | 1600 | 3800 | 6000 | 2200 | 3800 | - | - | - | 600 | 500 | 200 |
| 9 | 10200 | 6600 | 1900 | 4600 | 7400 | 2800 | 4600 | - | - | - | 800 | 600 | 200 |
| 10 | 13900 | 8900 | 2600 | 6300 | 10000 | 3700 | 6300 | - | - | - | 1000 | 700 | 200 |
| 11 | 17400 | 11130 | 3300 | 7900 | 12500 | 4700 | 7900 | - | - | - | 1200 | 900 | 300 |
| 12 | 18300 | 11800 | 3500 | 8300 | 13300 | 5000 | 8300 | - | - | - | 1400 | 1100 | 300 |
| 13 | 36700 | 23600 | 6900 | 16700 | 26600 | 10000 | 16700 | - | - | - | 2700 | 2000 | 600 |
| 14 | 45500 | 29200 | 8600 | 20600 | 32900 | 12300 | 20600 | - | - | - | 3200 | 2500 | 700 |
| **LoLo vessels** | | | | | | | | | | | | | |
| 4 | 1500 | 900 | 200 | 700 | 1000 | 300 | 700 | 1100 | 400 | 700 | 100 | 100 | 30 |
| 5 | 1900 | 1200 | 300 | 900 | 1300 | 400 | 900 | 1500 | 600 | 900 | 100 | 100 | 40 |
| 6 | 2600 | 1610 | 400 | 1200 | 1800 | 600 | 1200 | 2000 | 800 | 1200 | 200 | 100 | 60 |
| 7 | 3500 | 2100 | 500 | 1600 | 2400 | 700 | 1600 | - | - | - | 300 | 200 | 80 |
| 8 | 4700 | 2900 | 800 | 2100 | 3300 | 1100 | 2100 | - | - | - | 400 | 300 | 110 |
| 9 | 6200 | 4000 | 1200 | 2800 | 4500 | 1700 | 2800 | - | - | - | 600 | 400 | 140 |
| 10 | 8300 | 5300 | 1600 | 3800 | 6000 | 2200 | 3800 | - | - | - | 600 | 500 | 160 |
| **RoRo vessels** | | | | | | | | | | | | | |
| 5 | 7100 | 4400 | 1000 | 3300 | 4800 | 1500 | 3300 | 5500 | 2100 | 3300 | 400 | 300 | 130 |
| 6 | 9400 | 5800 | 1400 | 4400 | 6300 | 2000 | 4400 | 7200 | 2800 | 4400 | 600 | 400 | 170 |
| 7 | 11600 | 7300 | 1900 | 5400 | 8100 | 2800 | 5400 | - | - | - | 800 | 600 | 200 |
| 8 | 13800 | 8900 | 2600 | 6300 | 10000 | 3700 | 6300 | - | - | - | 1000 | 700 | 220 |
| 9 | 16100 | 10300 | 3000 | 7300 | 11600 | 4300 | 7300 | - | - | - | 1100 | 800 | 250 |
| **Tankers** | | | | | | | | | | | | | |
| 5 | 2200 | 1400 | 300 | 1000 | 1500 | 500 | 1000 | 1700 | 700 | 1000 | 100 | 100 | 40 |
| 6 | 2700 | 1700 | 400 | 1300 | 1800 | 600 | 1300 | 2100 | 800 | 1300 | 200 | 100 | 60 |
| 7 | 3300 | 2000 | 500 | 1500 | 2200 | 700 | 1500 | - | - | - | 200 | 200 | 70 |
| 8 | 4000 | 2500 | 700 | 1800 | 2800 | 1000 | 1800 | - | - | - | 300 | 300 | 90 |
| 9 | 4900 | 3100 | 900 | 2200 | 3500 | 1300 | 2200 | - | - | - | 400 | 300 | 110 |
| 10 | 5900 | 3800 | 1100 | 2700 | 4300 | 1600 | 2700 | - | - | - | 500 | 400 | 100 |
| 11 | 7200 | 4600 | 1400 | 3300 | 5200 | 2000 | 3300 | - | - | - | 600 | 500 | 100 |
| 12 | 8700 | 5600 | 1600 | 4000 | 6300 | 2400 | 4000 | - | - | - | 700 | 500 | 200 |
| 13 | 10600 | 6800 | 2000 | 4800 | 7700 | 2800 | 4800 | - | - | - | 800 | 600 | 200 |
| 14 | 12900 | 8200 | 2400 | 5900 | 9300 | 3400 | 5900 | - | - | - | 900 | 700 | 200 |
| 15 | 15700 | 10000 | 2900 | 7100 | 11200 | 4100 | 7100 | - | - | - | 900 | 700 | 200 |
| 16 | 19100 | 12100 | 3500 | 8700 | 13600 | 5000 | 8700 | - | - | - | 1100 | 800 | 200 |

* Actual output in kW needs to be taken into account in the calculations (above, 80% of maximum engine power assumed).

**Further information and more detailed instructions can be obtained from the following publication:**

*Update and Summary of Transport Emission Costs.* Ministry of Transport and Communications 2003.

## Noise costs

The unit values for noise costs (Table 14) are used in valuing the noise impacts in road but also rail and waterway projects.

No case-specific index adjustments may be made to the unit values.

*Table 14. Unit values for noise costs at the 2000 price level.*

| Daytime equivalent noise level (dB(A)) | Share of exposed population perceiving the level as disturbing | € annually per resident disturbed |
|---|---|---|
| 55 – 65 | 33% | 959 |
| 66 – 70 | 50% | 959 |
| 71 – | 100% | 959 |

**Further information and more detailed instructions can be obtained from the following publication:**

*Unit Costs in Road Transport 2000.* Finnish Road Administration 2001. (In Finnish)

## Accident Costs

The unit values for accident costs in road traffic (Table 15) are used in the valuation of safety impacts in rail and waterway projects in addition to road schemes.

No case-specific index adjustments may be made to the unit values.

*Table 15. Unit values for accident costs at the 2000 price level.*

| Result of accident/accident type | Cost (€) |
|---|---|
| Fatality | 1 934 161 |
| Permanent injury | 1 084 812 |
| Temporary injury | 151 369 |
| – serious | 260 691 |
| – slight | 50 456 |
| An injury on average | 248 077 |
| Fatal accident | 2 430 316 |
| Non-fatal injury accident | 315 352 |
| Injury accident on average | 386 832 |
| Non-injury accident | 16 819 |
| Road accident on average | 84 094 |

**Further information and more detailed instructions can be obtained from the following publication:**

*Unit Costs in Road Transport 2000.* Finnish Road Administration 2001. (In Finnish)

## APPENDIX 5. EXAMPLES OF PROJECT CARDS

**Sample one-page Project Card**

Logo of relevant Administration

# Name of Project

*Project Card*

Page 1/1

DATE

Map or other presentation giving an overall picture of the location and size of the project.

## THE PROJECT

Contents of the project is described by listing the central measures or groups of them (what is done and where) and the relevant quantity information (how much).

The planning and design status of the project is stated as well as the time when the project will be mature for implementation as far as planning, design and other processes are concerned.

## THE PRESENT SITUATION & PROBLEMS

The central background information is presented. It can consist of e.g. the following issues:

- traffic volumes and forecasts;
- land use and a forecast; and,
- the nature of the route and the traffic using it.

The problems for which the project has been initiated are described. They can be e.g. some of the following:

- insufficient capacity in view of the traffic volumes or their growth;
- poor level of service;
- technical outdatedness of the present solution;
- poor traffic safety;
- traffic noise nuisance; and,
- absence of groundwater protection.

## IMPACTS

The most important benefits of the project are described, e.g. as follows:

+ removal of capacity problems and improved smoothness of traffic;
+ enhanced supply and speed of public transport;
+ better conditions for pedestrian and bicycle traffic;
+ improvements in other level-of-service factors of the various modes of transport;
+ enhanced traffic safety; and,
+ decreased negative environmental impacts.

The most important disbenefits of the project are described, e.g. as follows:

– mere relocation of transport, environmental or safety problems;

– deterioration of the conditions for a certain transport mode, user group or area; and,

– damage caused by construction to natural or living environment.

The construction costs, the sources of funding and their shares, the price level of the cost estimate and the benefit-cost ratio of the project are presented.

Source of further information | Name, organization and telephone number of contact person

**Sample two-page Project Card**

Logo of relevant Administration

# Name of Project

*Project Card*

Page 1/2

DATE

Map or other presentation giving an overall picture of the location and size of project.

## PROJECT

Contents of the project is described by listing the central measures or groups of them (what is done and where) and the relevant quantity information (how much).

The planning and design status of the project is stated as well as the time when the project will be mature for implementation as far as planning, design and other processes are concerned.

## THE PRESENT SITUATION & PROBLEMS

The central background information is presented. It can consist of e.g. the following issues:

- traffic volumes and forecasts;
- land use and a forecast; and,
- the nature of the route and the traffic using it.

The problems for which the project has been initiated are described. They can be e.g. some of the following:

- insufficient capacity in view of the traffic volumes or their growth;
- poor level of service;
- technical outdatedness of the present solution;
- poor traffic safety;
- traffic noise nuisance; and,
- absence of groundwater protection.

## IMPACTS

The most important benefits of the project are described, e.g. as follows:

+ removal of capacity problems and improved smoothness of traffic;
+ enhanced supply and speed of public transport;
+ better conditions for pedestrian and bicycle traffic;
+ improvements in other level-of-service factors of the various modes of transport;
+ enhanced traffic safety; and,
+ decreased negative environmental impacts.

The most important disbenefits of the project are described, e.g. as follows:

– mere relocation of transport, environmental or safety problems;
– deterioration of the conditions for a certain transport mode, a group or an area; and,
– damage caused by construction to natural or living environment.

The construction costs, the sources of funding and their shares, the price level of the cost estimate and the benefit-cost ratio of the project are presented.

Source of further information | Name, organization and telephone number of contact person

**PROJECT CARD – Name of Project** Page 2/2

**Map** Date

A more detailed map than on page 1

Source of further information

Name, organization and telephone number of contact person

**Sample four-page Project Card**

Logo of relevant Administration

# Name of Project

*Project Card*

Page 1/4

DATE

Map or other presentation giving an overall picture of the location and size of project.

## PROJECT

Contents of the project is described by listing the central measures or groups of them (what is done and where) and the relevant quantity information (how much).

The planning and design status of the project is stated as well as the time when the project will be mature for implementation as far as planning, design and other processes are concerned.

## THE PRESENT SITUATION & PROBLEMS

The central background information is presented. It can consist of e.g. the following issues:

- traffic volumes and forecasts;
- land use and a forecast; and,
- the nature of the route and the traffic using it.

The problems for which the project has been initiated are described. They can be e.g. some of the following:

- insufficient capacity in view of the traffic volumes or their growth;
- poor level of service;
- technical outdatedness of the present solution;
- poor traffic safety;
- traffic noise nuisance; and,
- absence of groundwater protection.

## IMPACTS

The most important benefits of the project are described, e.g. as follows:

+ removal of capacity problems and improved smoothness of traffic;
+ enhanced supply and speed of public transport;
+ better conditions for pedestrian and bicycle traffic;
+ improvements in other level-of-service factors of other modes of transport;
+ enhanced traffic safety; and,
+ decreased negative environmental impacts.

The most important disbenefits of the project are described, e.g. as follows:

– mere relocation of transport, environmental or safety problems;

– deterioration of the conditions for a certain transport mode, a group or an area; and,

– damage caused by construction to natural or living environment.

The construction costs, the sources of funding and their shares, the price level of the cost estimate and the benefit-cost ratio of the project are presented.

Source of further information

Name, organization and telephone number of contact person

**PROJECT CARD – Name of Project** Page 2/4

**Description of Project** Date

## PRESENT SITUATION AND PROBLEMS

The background of the project, the problems it aims to solve and the forecasts used are presented more elaborately and argumentatively. The goals and possible connections to broader aims are stated.

## REFERENCE ALTERNATIVE

A description is presented on what will be done if the project will not be realized (the Do Nothing, Do Minimum or HET alternative).

## MEASURES AND COSTS

The contents of the project are described in more detail than in the abstract on page 1. The quantities and costs are broken down to a level that is natural in a summary.

## PLANNING AND DESIGN STATUS

The history of the project (the various planning, design and engineering documents and their years of completion) as well as the possible land use planning and permit processes are described. An estimate is presented concerning the implementation maturity of the project in these respects.

A more detailed map than on page 1 is presented. Depending on the case, the map may show either the Investment Alternative or both the Investment Alternative and the Reference Alternative.

Source of further information Name, organization and telephone number of contact person

**PROJECT CARD – Name of Project** Page 3/4

**Description of Impacts** Date

The impacts relevant for the project are grouped in a natural way and described. Quantitative data are presented where available. Tables and graphical illustrations may be used.

In a rail project, the grouping may be e.g. as follows:

- level of service of public transport;
- performance and costs of public transport;
- road transport and its costs;
- pedestrian and bicycle traffic;
- traffic safety;
- noise, emissions and energy consumption;
- land use structure and regional development;
- cityscape, landscape and the natural environment;
- mobility possibilities for different groups of population;
- maintenance costs of the transport network; and,
- impacts during construction.

In a road project, the grouping may be e.g. as follows:

- smoothness of traffic flows;
- performance and location of traffic;
- public transport;
- pedestrian and bicycle traffic;
- traffic safety;
- noise, emissions and energy consumption;
- land use structure and regional development;
- business life;
- cityscape, landscape and the natural environment;
- mobility possibilities for different groups of population;
- maintenance costs of the transport network; and,
- impacts during construction.

In a waterway project, the grouping may be e.g. as follows:

- logistical impacts;
- transport performances and the destinations of traffic;
- transport costs;
- safety and environmental risks;
- the aquatic environment and fishery;
- boating and recreation;
- costs of channel maintenance and ice breaking; and,
- impacts during construction.

Source of further information | Name, organization and telephone number of contact person

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**Description of Project** Date

## COST-BENEFIT CALCULATION

The central results of the cost-benefit calculation are described, the calculation values used are presented, and the results of sensitivity tests are summarized (with the help of a graph or a table, if deemed necessary).

If no calculation has been prepared, the reasons are given here.

A summary of the cost-benefit calculation is presented including the following:

- itemization of the benefits and costs;
- the investment cost and its interest for the construction period;
- the benefit-cost ratio; and,
- the present value and other indicators.

## FEASIBILITY

The central issues in the feasibility assessment of the project are described.

## EFFECTIVENESS ASSESSMENT

A summary of the results of the effectiveness assessment is presented. The main headings are the same as in the assessment itself:

- daily mobility;
- business life;
- regional development;
- the environment;
- traffic safety; and,
- economy.

The summary also needs to express to which extent the various impacts have been considered in the cost-benefit calculation.

Source of further information Name, organization and telephone number of contact person